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14 November 1979

# USSR REPORT

## ELECTRONICS AND ELECTRICAL ENGINEERING

No. 52

This serial publication contains articles, abstracts of articles and news items from USSR scientific and technical journals on the specific subjects reflected in the table of contents.

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CONTENTS	PAGE
Amplifiers .....	1
Antennas .....	4
Certain Aspects of Computer Hardware, Soft Ware; Control, Automation, Telemechanics and Machine Planning .....	9
Certain Aspects of Television, Photography and Motion Pictures ...	13
Certain Aspects of Radioastronomy, Satellites and Space Vehicles .	15
Communication, Communication Equipment, Networks, Data Transmission and Processing .....	16
Components and Circuit Elements, Including Waveguides and Cavity Resonators .....	33
Converters, Inverters, Transducers .....	46
Cryogenics and Superconductivity .....	50
Electrical Engineering Equipment and Machinery .....	54
Electroacoustics .....	65
Electromagnetic Wave Propagation; Ionosphere, Troposphere; Electrodynamics .....	66
Electron and Ion Devices .....	71
Electron Tubes, Electrovacuum Technology .....	72
General Circuit Theory and Information .....	77
General Production Technology .....	79
Instruments, Measuring Devices and Testers; Methods of Measuring .	80
Materials .....	92
Oscillators, Modulators, Generators .....	97
Power Systems [including effect of various items on power transmission lines]	100



CONTENTS	PAGE
Photoelectric Effect .....	102
Quantum Electronics .....	105
Radars, Radio Navigation Aides, Direction Finding, Gyros .....	106
Receivers and Transmitters .....	109
Semiconductors and Dielectrics .....	111
Theory .....	115

USSR

UDC: 621.077

## AUTOMATIC STABILIZATION OF A PHASE INCURSION IN AN AMPLIFIER OF A SINGLE-BAND SIGNAL

Moscow RADIOTEKHNIKA, Vol 34, No 6, Jun 79, pp 52-55 manuscript received after completion, 16 May 78

KHARITONOV, A. V.

[Abstract] Creation of power transistorized amplifiers of a single-band signal which operate in a wide frequency band without retuning, and an increase of efficiency and a decrease of a nonlinear distortions of such an amplifier are problems of current interest, the most promising solution of which is the method of separate amplification of the components of an OM (single-band modulation) signal. As shown in the literature, one of the principal sources of distortions in an amplifier constructed by the method of separate amplification is amplitude--phase conversion (APK), i.e., dependence of the phase of the output signal of the amplifier on the amplitude of the signal at its input. For a decrease of the APK and thus the distortions it has been proposed to use a device for automatic stabilization of a phase incursion in an amplifier (ASFN). In the present paper problems of achieving a wide-band ASFN device are considered, as applied to an amplifier of OM oscillations, and an evaluation is made of the effect of ASFN on the level of the combination distortions of the output signal of an amplifier during testing on a two-tone signal. Figures 4; references: 5 Russian.

[254-6415]

USSR

## A WIDE-BAND POWER AMPLIFIER

Moscow RADIO in Russian No 6, 1979 p 43

GAREVSKIKH, I., Moscow

[Abstract] In conventional wide-band amplifiers, dynamic distortions arise due to use of an asymmetric output stage (current amplifier in one arm and voltage amplifier in the other). This article describes an improved wide-band power amplifier in which dynamic distortions are minimized by symmetrizing the arms in the output stage to reduce the phase shift of the output signal. The range of reproducible frequencies is 20-20,000 Hz with nonuniformity of the amplitude-frequency response not exceeding 1 dB. Sensitivity is 0.7 V and output power is 30 W with 8-ohm load impedance.

A further reduction in phase shift is realized by using two-stage current amplifiers instead of the conventional three-stage amplifiers, and by reducing the time constants of the collector circuits in the differential stages. As a result, the self-excitation frequency is rather high and can be eliminated by introducing a minimum phase correction. Alignment is described. Figure 1.

[253-6610]

USSR

UDC: 621.375.049.77

#### NOISE FACTOR OF TRANSISTORIZED RC-AMPLIFIER WITH QUASI-RESONANCE

Moscow RADIOTEKHNIKA, Vol 34, No 6, Jun 79, pp 62-63 manuscript received 24 Jun 78

BORISOV, E. V.

[Abstract] The development of integrating technics has lead to the necessity for development of new methods of wide-band amplification without the use of inductive elements. One of the possible solutions for this problem is considered in a paper by V. I. Moskvitin (RADIOTEKHNIKA. 1976, Vol 31, No 9) where the amplitude-frequency characteristic of a transistorized amplifier is analyzed and the mechanism is explained of a resonance phenomenon caused by feedbacks through the capacitance  $C_k$  (collector channel) and the capacitance  $C_e$  (emitter channel). As  $C_k$  it is possible to use the capacitance of the collector junction or especially to include a capacitor. Because during designing of RC-amplifiers it is necessary to evaluate not only their frequency-selective properties but also their sensitivity, the present paper obtains relationships for the noise factor of a wide-band RC-amplifier with quasi-resonance. The results are presented of investigations of the magnitude of the noise factor in the frequency range. Figures 3; references: 3 Russian.

[254-6415]

## DESIGN OF THE INPUT STAGES FOR SINGLE-BAND PUSH-PULL TRANSISTOR POWER AMPLIFIERS

Moscow RADIOTEKHNIKA in Russian, Vol 34, No 7, Jul 79 pp 24-25 manuscript received 14 Jun 78

KONTOROVICH, V. I.

[Abstract] The optimum energy and distortion characteristics of a transistor power amplifier for a single-band signal are attained when the collector current cutoff angle remains constant and equal to  $90^\circ$  over the operating frequency range as the amplitude of the input signal varies. Here the circuit equations for the input stage of a push-pull amplifier, with a transistor ON and a transistor OFF, are written in terms of the emitter-base voltage so that the time constants and all resistances can be selected. Figures 2; references: 2 Russian.

[270-2415]

AN AMPLIFIER BASED ON FIELD-EFFECT TRANSISTORS WITH A P-N JUNCTION AND LOW  $1/f$ -NOISE

Moscow IZMERITEL'NAYA TEKHNIKA in Russian, No 3, Mar 79 pp 38-39

LEVINZON, F. A. and TRESHCHEV, V. M.

[Abstract] Latest improvements in the technology of field-effect transistors make these devices suitable for VLF amplifiers, where a low  $1/f$ -noise is desirable. Here the KPS104A transistor is proposed for use as the active element in high-sensitivity infra-audio amplifiers, inasmuch as noise measurements in  $1/3$ -octave bands with a spectrum analyzer in a special test circuit indicate an almost complete absence of  $1/f$ -noise at frequencies up to 2 Hz. This compares favorably with the characteristics of a pair of KP303G field-effect transistors in parallel tested in another amplifier in series with the KPS104A amplifier, although the noise of a parallel KP303G pair is lower at audio frequencies above Hz because of a lower thermal noise. Another advantage of a KPS104A amplifier is that it does not require two devices with identical parameters. Figures 2; references 10: 4 Russian, 6 Western.

[248-2415]

USSR

UDC: 621.372.54:621.327.8.001.24

## WAVES OF A BICONICAL HORN ANTENNA

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1017-1026  
manuscript received 29 May 78

VILKOVA, L. P. and NEFEDOV, YE. I.

[Abstract] The authors discuss some properties of waves of a biconical horn antenna with ideally conductive walls. The boundary value problem is formulated and characteristic equations are derived for the electric and magnetic fields. Numerical analysis of these equations for higher wave modes shows how electric and magnetic waves behave as a function of waveguide geometry and as a function of the transverse mode indexes  $m$  and  $p$ . An anomaly is observed in the behavior of  $H_{m1}$  waves ( $m=1, 2, \dots$ ), and on this basis an examination is made of the feasibility of making open biconical resonators with reflectors that are nonfocusing from the geometric standpoint. An analogous anomaly is observed in the behavior of  $H_{mp}$  waves ( $m=1, 2, \dots, p=2, 3, \dots$ ). Figures 6; references: 13 Russian.

[244-6610]

USSR

UDC: 621.396.67

## ON THE FEASIBILITY OF USING THE RADIATION OF A 'BLACK' DISK IN THE NEAR ZONE FOR ABSOLUTE MEASUREMENTS OF SCATTERING AND GAIN OF AN ANTENNA WITHOUT ANTENNA FOCUSING

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 22, No 6, 1979 pp 770-772  
manuscript received 3 Aug 78

BELOV, YU. I., VEKSLER, N. V., SEMENOVA, L. R. and FOGEL', A. L., Scientific-Research Institute of Radio Physics

[Abstract] The "black" disk method of measuring the scattering and gain of an antenna requires that the disk be located in the far zone of the antenna, or else must provide for focusing the antenna on a disk in the near zone. These conditions may be either impossible or inconvenient in practice. At the same time, the phase-meter method enables determination of these characteristics by combining "black" disk measurements in the near zone without antenna focusing with measurement of the amplitude-phase distribution of the field of a monochromatic signal on a surface coincident with the surface of the disk. In this paper a method is proposed for measuring the integral characteristics of the antenna based on the phase-meter technique. The described approach is confirmed by

experimental measurements on a 7-meter parabolic Cassegrain antenna. The authors thank N. M. Tseytlin and V. I. Turchin for discussion and constructive criticism. Figures 1; references 5: 4 Russian; 1 Western.

[251-6610]

USSR

UDC: 621.396.96.02

#### SIGNAL-TO-NOISE RATIO IN MULTIPLICATIVE ANTENNAS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79  
pp 1005-1010 manuscript received 23 May 77

LATKO, YU. I.

[Abstract] A multiplicative antenna is an antenna aperture divided into two parts with multiplication of the combined outputs. Such a device is used to modify the radiation pattern for maximizing resolution. Research on such antennas over the past 2 decades has dealt with radiation patterns, resolution, and detection characteristics. In this paper the author considers the change in signal-to-noise ratio in multiplicative antennas due to signal processing (multiplication). An estimate is made of the influence that signal multiplication has on the probability of false alarms at the multiplier output. The results are compared with signal summing and squaring. References 7: 6 Russian; 1 Western.

[244-6610]

USSR

UDC: 621.396.677

#### RECURRENCE METHOD OF DESIGNING A SERIES NETWORK FOR FORMING THE RADIATION PATTERN OF ANTENNA ARRAYS

Moscow RADIOTEKHNIKA in Russian Vol 34, No 7, Jul 79 pp 64-66 manuscript received 29 Jul 79

ZVYAGEL'SKIY, V. S., KREMENETSKIY, S. D., LOS', V. F. and NOVOSARTOV, M. T.

[Abstract] Radiation patterns of multibeam antenna arrays are formed with a pattern shaping network. The efficiency of channels in a series network depends not only on the intersection level of adjacent beams and on their shape but also, unlike in a parallel network, on their consecutive number.

Here a method of synthesizing such a Blass network on this basis is shown, not according to the theory of matrices (which would be mathematically difficult) but with the aid of rather simple recurrence relations applicable to arbitrary intersection levels of partial beams and to diverse amplitude-phase distributions in the aperture. Assuming no interaction in the outer space, this method is demonstrated on a series pattern forming network with M vertical inputs and N horizontal outputs, all connected to radiators in the array, and with a column of N phase shifters establishing the given initial phase distribution in the aperture. Power and efficiency at each node are calculated by numerical simulation on an M-220 computer, according to a program written in ALGOL. The authors thank T. YU. ALEKSANDROVA for writing the program and performing the calculations for a typical illustrative example. Figures 3; references: 5 Russian.

[270-2415]

USSR

UDC: 621.396.677.49

#### PHASE SYNTHESIS OF AN EMITTER-EQUIVALENT ANTENNA ARRAY

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1979 pp 906-912 manuscript received 2 Jun 76; after revision, 26 Dec 77

LUCHANSKAYA, KH. I. and KHEVROLIN, V. YA.

[Abstract] An antenna array with a directionality similar to a single emitter is investigated. An emitter-equivalent antenna derived as a result of amplitude-phase synthesis has significant losses in emitting power as compared to uniform excitation. Phase synthesis of emitter-equivalent antenna arrays in the Chebyshevskiy approximation consists in finding phases which maximize the minimum value of the modulus of the antenna multiplier in all ranges of variation of the angle between the antenna axis and the direction toward the observer. The problem can be solved on a digital computer by the iterative method. Maximized function of the minimum is multiextremal, while the iterative methods are local in nature. Thus the success of deriving the global maximum is determined by selection of the initial approximation and the presence of a criterion of validity for the solution derived. The level of minimum emission of these arrays and the boundary conditions of minimum emission are given in tabular form. Figures 3; Tables 2; references: 4 Russian.

[230-8617]



## CONCERNING ELECTRICAL SCANNING IN ELEVATION PLANE WITH THE USE OF THE EFFECT OF THE EARTH'S SURFACE

Moscow RADIOTEKHNIKA, Vol 34, No 6, Jun 79, pp 23-31 manuscript received 19 Apr 78

VOL'PERT, A. R.

[Abstract] Direction finding of the angular altitude of various sources of oscillations is ordinarily connected with difficulties caused by waves reflected from the surface of the earth. Methods making it possible to use these effects include a method based on the use of a variable phase distribution of a field along the length of some vertical antenna. The present paper investigates this method, discussing in turn initial relationships, comparison of phase scanning with the method under consideration, the effect of the characteristic amplitude diagram of half period sections, orientation of the maximum of radiation with a non-whole number of half periods, and the effect of the parameters of the soil. Figures 8; references 6: 3 Russian; 1 Western.

[254-6415]

## RADIATION CHARACTERISTICS OF A PERIODIC ARRAY OF WAVEGUIDES WITH AN ARBITRARY CROSS SECTION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1291-1300 manuscript received 14 Jun 78

GRIN'EV, A. YU., IL'INSKIY, A. S., KOTOV, YU. V. and CHEPURNYKH, I. P.

[Abstract] The radiation characteristics of periodic antenna arrays consisting of identical waveguides with an arbitrary cross section are analyzed by a combination of two methods. The amplitudes of waveguide and space harmonics for regions I and II inside and between the waveguides respectively are calculated by the projection method with collocation of fields. The complete system of waveguide harmonics for region I inside the waveguides is determined by the method of finite elements. The algorithm includes calculation of the vector functions for E-modes and H-modes through the scalar function, a boundary-value problem for the Helmholtz equation, and coefficients of the scattering matrix. The algorithm has been programmed on a BESM-6 high-speed computer. The results of numerical solution yield the dependence of reflection and transmission coefficients on the frequency and on the scan angle for various



given geometrical array proportions. These results are useful for antenna design and optimization of their energy, frequency, and polarization characteristics. The algorithm and its program can be included in an appropriate automated design system. Figures 6; references 11: 5 Russian, 6 Western.

[273-2415]

USSR

UDC: 62-503.53

INFLUENCE OF RANDOM SIGNALS ON OPERATION OF TRACKING SYSTEMS WITH VARIOUS  
STRUCTURES

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 79 pp 599-604  
manuscript received 8 Feb 77

BOROVIKOV, MIKHAIL ALEKSEYEVICH, candidate in technical sciences, docent,  
and DOMANOV, Viktor Ivanovich, junior research worker, Ul'yanovsk Poly-  
technical Institute

[Abstract] Two tracking systems are compared for minimum variance and torque on the actuating motor when subjected to random interference from feedback sensors. It is found that there are regions of the parameters  $x$  of the system and the parameters  $y$  of the interference where preference should be given to certain methods of correction. The analysis of the control structures is done by linear methods, and therefore the results are only approximate. It is found that time-lead correction gives the best parameters for both systems. A system with subordinate regulation is preferable in the case of low-frequency interference. Figures 4; references: 5 Russian.

[276-6610]

USSR

UDC: 65.012.122:655.512

CONCERNING ONE WAY OF ARRANGING CRITERIA ACCORDING TO IMPORTANCE

Moscow AVTOMATIKA I TELEMEXHANIKA in Russian No 4, 1979 pp 67-71 manuscript  
received 12 Jun 78

BEREZOVSKIY, B. A. and KEMPNER, L. M., Moscow

[Abstract] In many practical problems, objects are compared with respect to several indices in order to find those that are in some sense preferable. In the case where it is only known how the objects are arranged with respect to each index, and no information is available on the relation between indices, the Pareto-optimum objects are usually taken as most preferable. However, as a rule the number of Pareto-optimum objects exceeds the sampling limit. Therefore it frequently is necessary to determine the relation between indices, and to utilize this information to construct preference relations that usually comprise a Pareto set. In this paper the authors consider indices of arbitrary nature, and introduce the concept of "ordered indices" with investigation of a recursion preference relation based on information concerning the arrangement of indices. The concept of Z-optimality

is introduced, and the properties of this concept are studied. It is shown that the set of Preto-optimum objects subsumes the set of Z-optimum objects. References 4: 3 Russian, 1 Western.

[256-6610]

USSR

UDC: 616-07:62-50

#### DIAGNOSIS OF OBJECTS DESCRIBED BY LARGE TABLES OF EXPERIMENTAL DATA

Moscow AVTOMATIKA I TELEMEXHANIKA in Russian No 4, 1979 pp 101-108 manuscript received 15 Mar 78

GOL'DMAN, R. S. and MAKHOV, V. N., Vladivostok

[Abstract] In problems of technical and medical diagnosis, geological forecasting, industrial oceanography, meteorology and so forth, extensive use is made of various methods of analyzing the state of objects according to a set of features that characterize these objects. In this paper the authors propose a method of diagnosing objects when features are measured in different scales, and are represented in extensive tables of experimental data, where the purpose of the diagnosis is to define certain goal features. The method is illustrated by an example of forecasting minimum air temperature over a 24-hour period. Figures 1; tables 5; references 18: 17 Russian, 1 Western.

[256-6610]

USSR

UDC: 621.372.54.088

#### A SPECTROTRON BASED ON A DELAY LINE

Moscow RADIOTEKHNIKA in Russian Vol 34, No 7, Jul 79 pp 30-32 manuscript received; after completion, 31 Jan 79

MALAFEYEV, V. M. and TUZOV, V. M.

[Abstract] Spectrotrons are nonautonomous multistable harmonic-frequency devices used in special-purpose computer systems for data processing and in digital automation. Since the oscillatory LC circuit in such a device presents a technological problem, the feasibility is considered of using a selective amplifier with a 2-stage delay-line feedback and with electronic

frequency tuning. The theoretical analysis is based on the method of slowly varying amplitudes, applied to the system of differential equations with a delay argument which describe the spectrotron performance. After these equations have been solved graphoanalytically, the stability condition is established according to the Routh-Hurwitz criterion. Figures 2; references: 3 Russian.

[270-2415]

USSR

UDC: 621.374.32

#### A REVERSIBLE COUNTER WITH DIGITAL DISPLAY

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 pp 104-106  
manuscript received 18 Jan 77

ABDUKAYUMOV, A., AKHMEDOV, R. G., SOSNOVSKIY, R. O. and KHALIKOV, A. A.,  
Tashkent Polytechnical Institute

[Abstract] A reversible ring counter based on high-voltage transistors is described that does not require a decoder or a device for controlling a series IN digital display. Counting direction is easily changed. The circuit consists of ten cells based on transistors with different conductivity types. Each cell has two stable states. The combination gives a flip-flop with 10 stable states. Maximum count rate is 100 kHz. A diagram is given for a five-place counter for indication of the position of the output shaft of a discrete-action drive. The range of supply voltage for stable operation is 40-50 V, and the amplitude of input pulses ranges from 0.9 to 6 V. Minimum duration of input pulses is 6.5  $\mu$ s, maximum duration is 650 ms, and power consumption is about 1 W per decade. Figures 1; references: 1 Russian.

[261-6610]

USSR

UDC: 681.3

#### A DEVICE FOR PUNCHTAPE OUTPUT OF INFORMATION FROM DIGITAL EQUIPMENT

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 pp 100-102  
manuscript received 23 Feb 78

BAZAROV, G. I., Moscow State University

[Abstract] A device is described for punchtape output of data from digital

measuring instruments. In addition to the punching function, this device can be used for direct input of digital readings (in binary-decimal code) to "Mir-1" computers. The interface is made almost entirely of components that are standard for the "Mir-1." A block diagram is given and the working sequence is described. Information in the form of four-place decimal numbers can be read out simultaneously from two instruments at a rate of 4 Hz. The interface has been successfully used in optics experiments at Moscow State University. The measuring instruments in this application were digital frequency meters. The author thanks A. F. Aleksandrov for discussion and interest in the work. Figures 1.

[261-6610]

USSR

UDC: 681.142.621

#### A HIGH-SPEED ANALOG MEMORY WITH TWO-STAGE CONVERSION CYCLE

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 78 pp 103-104  
manuscript received 6 Dec 77, after revision 5 Sep 78

DEMCHUK, M. I. and KHAYMINOV, V. N., Scientific-Research Institute of Applied Physics Problems, Belorussian State University, Minsk

[Abstract] An analog memory is described that combines simplicity with speed and accuracy of analog signal conversion. The circuit uses two stages of conversion of the input signal and a linear gate of series-parallel type based on a diode bridge circuit. The input signal range is  $\pm 5$  V, and the pedestal at the output of the linear gate in the closed state is of the order of 5 mV or less. The minimum duration for gate disengagement is about 5 ns. Potential leakage from the storage capacitor is about 2 or 3 mV/s, and the temperature drift of the output signal in the time range of amplitude storage in the capacitor between 1  $\mu$ s and 10 ms is 5-20 mV. Temperature drift of the output signal at room temperature after 2 hours of operation does not exceed 20 mV. This circuit has been used in a multichannel stroboscopic analyzer for laser probing of optically dense layers of the atmosphere. Figures 1; references 5: 4 Russian, 1 Western.

[261-6610]

USSR

UDC: 621.397

OPTIMUM CRITERION FOR OPERATING ZONES OF SPECTROZONAL TELEVISION SYSTEMS

Moscow RADIOTEKHNKA, Vol 34, No 6, Jun 79, pp 33-37 manuscript received 18 May 78

ZUBAREV, YU. B.

[Abstract] Spectrozoal television systems (STS) are one of the means which make it possible to achieve methods of distant investigation of the natural resources of the earth. STS, which can be widely used in both the industrial and agricultural sectors, are a new class of multispectra systems which operate in several spectral bands on the principle of perception of energy reflected from some objects. An accurate choice of operating zones determines the efficiency of operation of multaspectral systems and makes it possible to minimize the probability of error during discrimination of the signal of the object and background. The present paper considers the problem of a choice of optimum operation zones for STS which is completely determined by the optimum criterion. The choice of the criterion is accomplished on the basis of minimizing the level of probability of errors. Inasmuch as with other criteria of detection (e.g., the Neumann-Pearson criterion), the structure of the optimum detector does not depend on the form of the criterion, then maximization of the difference module has a common character for the criteria of detection in spectrozoal television systems. Figures 2; references: 4 Russian.

[6415]

USSR

UDC: 621.397

DERIVATION OF THE FORMULA FOR CALCULATING THE UPPER CUTOFF FREQUENCY OF A TELEVISION SIGNAL

Moscow RADIOTEKHNKA in Russian Vol 34, No 7, Jul 79 pp 57-59 manuscript received 16 Oct 78

IGNAT'YEV, N. K.

[Abstract] The formula according to F. Schroter (1929) for the upper cutoff frequency of a television signal  $f_u = \frac{1}{2} k z^2 f_f$  Hz ( $f_f$  denoting the frame frequency,  $z$  denoting the number of sweep lines, and the width-to-height ratio  $k$  characterizing the frame form) is reviewed from the standpoint of change from the exactly rectangular raster and square aperture in Schroter's mechanical sweep system with a sequence of discrete brightness levels to a continuous signal with the narrowest frequency band permissible in modern electronic sweep systems. Such a change leads, coincidentally and

without a scientific basis, to the same result as does the Kotel'nikov theorem. With several still debatable aspects considered, the same formula for the upper cutoff frequency is derived from the pulse response of a low-pass filter equivalent to the aperture and, through a Fourier transformation, the amplitude spectrum of a television signal. Figures 1; references 2: 1 Russian, 1 German.

[270-2415]



USSR

UDC: 523.164.8:523.53.7

MEASUREMENT OF SPECTRA OF TWO COHERENT RADIO SIGNALS FROM VENERA-10  
SPACE PROBE NEAR THE SUN IN JUNE 1976

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1979 pp 881-885 manuscript received 17 Aug 78

ALEKSANDROV, YU. N.; VASIL'YEV, M. B.; VYSHLOV, A. S.; DUBROVIN, V. M.; ZAYTSEV, A. L.; KOLOSOV, M. A.; LAPTEV, N. V.; PETROV, G. M.; ROGAL'SKIY, V. I.; SAVICH, N. A.; SAMOZNAYEV, L. N.; SIDORENKO, A. I. and KHASYANOV, A. F.

[Abstract] First measurements of the width of spectral lines of monochromatic radiowaves passing around the Sun made on the flights of Mariner 4, Pioneer 6 and Mars 2.7 confirmed earlier assumptions that the non-uniformity of the perisolar plasma should induce expansion of the energy spectrum of radio signals. The flight of Venera-10, which had coherent radio transmitters for the decimeter and centimeter ranges, enabled the first dual-frequency radioscopy of perisolar space in June, 1976. Expansion of the spectral line of a centimeter signal at  $R/R_0$  less than or similar to 10 is much less than was anticipated, based on measurements in the decimeter range and the known theory of occurrence. The effect observed can not be completely explained by more intense refraction of decimeter radio beams. Figures 3; references 11: 4 Russian; 7 Western.

[230-8617]



USSR

UDC: 533.951

PECULIARITIES OF DISTORTIONS OF AM AND FM SIGNALS REFLECTED FROM AN  
EPSTEIN LAYER

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 22, No 6, 1979 pp 703-710  
manuscript received 21 Apr 78; after completion, 10 Nov 78

ANYUTIN, A. P., Moscow Institute of Radio Engineering, Electronics and  
Automation

[Abstract] An analysis is made of distortions of AM and FM signals reflected from an inhomogeneous plasma layer (Epstein layer) where the electron concentration varies according to the law  $N_e = N_m \operatorname{sech}^2 \left( \frac{z - z_m}{D} \right)$ , where  $z_m$  is the distance at which the electron concentration is maximum and equal to  $N_e = N_m$ , and  $D$  characterizes the effective thickness of the layer. A strict solution of the problem of dispersion distortions of radio signals is used for numerical and asymptotic studies. Typical results are given showing the influence that the type of signal modulation, critical frequency and thickness of the layer have on signal distortions. It is shown that oscillations of signal envelopes can be attributed to the interference of principal and fringe space-time beams. Figures 6; references 16: 11 Russian, 5 Western.

[251-6610]

USSR

UDC: 621.3.019.4

RECEPTION OF MULTIFREQUENCY SIGNALS UNDER CONDITIONS OF MULTIBEAM PROPAGATION WITH LUMPED INTERFERENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1339-1350 manuscript received 12 Apr 78

FAL'KO, A. I. and SHLYAKHOV, I. M.

[Abstract] Reception of multifrequency signals in a Rayleigh channel by two methods is evaluated with respect to interference immunity. The first method is spacing such a signal over discrete beams with different time delays. The second method is frequency spacing of such a signal. Both methods ensure the same immunity to lumped interference, with reception according to the optimal maximum-likelihood algorithm, regardless of the number of signal components and the number of beams arbitrarily delayed relative to one another. The suboptimal quadratic-addition algorithm, which becomes identical to the optimal algorithm

in the case of complete beam separation or in the case of uncorrelated fading processes, is much simpler and preferable in the case of missing a priori information about the correlation matrices. With reception according to this algorithm, beam spacing ensures a better interference immunity when the number of signal frequencies is larger than the number of beams and frequency spacing ensures a better interference immunity when the number of signal frequencies is smaller than the number of beams. With small beam delays, moreover, the interference immunity is worst during rejection of extreme frequency components. With large beam delays, on the other hand, the interference immunity depends only on the number of signal components but not at all on the combination of rejected and accepted ones. Figures 3; references: 6 Russian.

[273-2415]

USSR

UDC: 621.385.001.6

ON ELECTRON BEAM INTERACTION WITH THE MICROWAVE FIELD OF A PLANE GAP

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 5, 1979 pp 1004-1010 manuscript received 20 Jan 78

MALYKHIN, A. V. and PETROV, D. M.

[Abstract] Most mathematical difficulties in the theory of electronic devices are associated with the solution of equations of motion on whose left side particle velocity is given as a function of the "current" and initial moments in time (Lagrange variables); on the right hand side, electrical and magnetic fields are defined from Maxwellian equations for "current" coordinates and time (Euler variables for a one-dimensional approximation). In analyzing the interaction of electron flux with an shf (microwave) field, it is more preferable to use analytical methods whose primary merits are the analytical functional connection between the corresponding quantities, clarity of the results obtained, and extremely small computer operation time. In the problem of a plane gap, there is a constraint on the amplitude of shf-voltage associated with a narrowing of the region of assignment of functions of the coordinate and velocity of every particle investigated. The region of the monotron effect decreases when "plasma" frequency is increased and is displaced toward the greater values of the static angle of transit. Figures 5; references: 6 Russian.

[230-8617]

## INVESTIGATION OF HIGH-FREQUENCY FEEDBACK WITH FREQUENCY CONVERSION OF THE AMPLIFIED SIGNAL

Moscow RADIOTEKHNIKA, Vol 34, No 6, Jun 79, pp 74-77 manuscript received 28 Sep 78

TAMM, D. L. and SHIPITSYN, A. A.

[Abstract] In amplifiers of the power of a single-band signal, constructed according to the principle of wide-band amplification, it is impossible to use a sufficiently deep-seated high-frequency negative feedback in its "classic" form. The principle of construction of high-frequency feedback suitable for use in wide-band amplification is found in a work by L. Chantelove (The New Thomson CFS Solid-State Modular ISB Transmitters. Telenide: 1970, I-VIII, No 3): a signal from the output of a transmitter is transferred to one of the intermediate frequencies for forming a single-band signal  $f_0$  and at this, invariable for any performance of the transmitter, the required form of the amplitude-frequency characteristic of the signal transmission with respect to the feedback circuit and the antiphase nature of the driving voltage and the reverse supply are assured to the frequency. However, neither a method of constructing a device for forming the amplitude-frequency characteristic, or the stability are considered in this work, so the present paper is devoted to consideration of these and certain other features of achieving a negative feedback at the intermediate frequency  $f_0$ . Figures 5; references 4: 3 Russian, 1 Western.

[254-6415

## EVALUATION OF NOISE IMMUNITY OF TELEPHONE COMMUNICATION CHANNEL WITH DELTA MODULATION

Moscow RADIOTEKHNIKA, Vol 34, No 6, Jun 79, pp 60-62 manuscript received 18 Oct 77

KHMELEVSKIY, I. V.

[Abstract] The noise immunity of a communication channel is analyzed for the case of optimum nonlinear processing of a discrete signal. The parameters of the channel were: cadence frequency, 25 kHz; transmission band, 300-3300 Hz;  $L = 16 \pm 64$ . Dependences are obtained characteristic of the algorithms of filtering of a discrete signal and the communication channel as a whole. It is shown that the maximum gain possible as the result of nonlinear processing with a fixed magnitude of the total

probability of errors of filter discrimination amounts to 2 db. Optimization of the evaluated filter of a discrete signal increases the intelligibility of speech at the output of a communication channel with a fixed L and Q by not more than two percent. Symmetry of errors of the first and second kind do not make it possible to increase the noise immunity of a channel by use of a demodulator with a finite memory. A decrease of L significantly worsens the noise immunity of a communication channel. Figures 2; references: 4 Russian.

[254-6415]

USSR

UDC: 621.391.019.4

#### PERIODIC CROSS-AMBIGUITY FUNCTIONS OF ZINGER CODES AND SIDE-LOBES SUPPRESSION FILTERS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 5, 1979 pp 936-939  
manuscript received 5 Nov 77

IPATOV, V. P.; KORNIYEVSKIY, V. I. and SAMAROV, V. I.

[Abstract] Signals constructed on the basis of Hoffman, Legendre, Hall and Jacobi sequences are among the commonly used periodic phase-manipulated (PFM) signals. These signals are of interest because of their low periodic function of indefiniteness (PFN) on the time axis of the time-frequency plane, as well as the relatively uniform distribution of side-lobes of PFN throughout the entire plane. Comparison of the corresponding graphs shows that the PFM-signal/filter pair investigated, while not inferior to matched processing of Hoffman and Legendre sequences in the level of side-lobes in the entire time-frequency plane, is substantially better in that indication in the zone of small Doppler frequency shifts. Figures 1; references: 4 Russian.

[230-8617]

## OPTIMUM NUMBER OF CHECKS TO DETECT A PERIODIC SIGNAL SEQUENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 5, 1979 pp 1070-1073 manuscript received 4 Oct 76; after revision, 20 Mar 78

ANDREYEV, V. P. and TSIKIN, I. A.

[Abstract] The problem of detection of the start of a periodic sequence of signals often has to be solved in the construction of radio equipment. In discrete data transmission systems, a periodic sequence may precede the information sequence and be used to synchronize the receiving device with the signal arrival. Results show evidence that the quantity  $l_{opt}$  (probability) depends considerably on the probability of false alarm, as well as on the ratio of signal energy to the spectral density of noise output. At very great signal energies,  $l = 1$  is optimum in the entire range of false alarms. On the other hand, at lower signal energies, the use of  $l = 2$  at point  $P_{false-alarm} = 10^{-6}$  instead of  $l = 3$  would lead to  $\bar{T} = 9.2 T_s$  instead of  $\bar{T} = 5.0 T_{signal}$ , if the true values of  $\bar{T}$  are similar to the upper estimate of  $\bar{T}_{upper}$ . Figures 1; references: 1 Russian.

[230-861?]

## PROBABILISTIC CHARACTERISTICS OF A NARROW-BAND SIGNAL AND QUASI-HARMONIC INTERFERENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1220-1224 manuscript received 14 Apr 77

RUBTSOV, V. D.

[Abstract] An examination is made of the probabilistic characteristics of a narrow-band signal  $s(t) = S(t) \cos [\omega t - \psi(t)]$  in a mixture with a quasi-harmonic waveform  $n(t) = N(t) \cos [\omega t - \phi(t)]$  with random phase uniformly distributed on the interval  $[-\pi, \pi]$  and a deterministic envelope. It is found that in the weak-signal case the phase distribution differs considerably from that for a narrow-band signal and normal interference. In the strong-signal case, the distribution becomes cosinusoidal as in the mixture with normal interference. An expression is derived for the probability density function that is used to calculate the phase fluctuation variance necessary for analyzing the accuracy characteristics of a phase meter. Figures 5; references: 3 Russian.

[244-6610]

## EFFICIENCY OF A NONPARAMETRIC RANK DETECTOR IN THE PRESENCE OF INTERFERENCE REMAINING NONSTATIONARY DURING THE REFERENCE-SAMPLING INTERVAL

Moscow RADIOTEKHNIKA in Russian Vol 34, No 7, Jul 79 pp 37-41 manuscript received, after completion, 18 Sep 78

LEDOVSKOY, V. N. and SHIGIN, V. A.

[Abstract] Nonparametric detection is quite competitive with adaptive detection in the case of fast-varying interference, especially with the aid of an automatic system. Here the efficiency of Wilkinson 2-sample detector is evaluated which essentially calculates the rank  $R$  of a distance element reading relative to  $n$  readings in the reference sample and, when  $R = n + 1$ , indicates the presence of a signal. Interperiodic processing is also considered, taking into account the simultaneous presence of inherent receiver noise and intermittent interference or random pulses, whereupon the probabilities of false alarm and of correct detection are calculated, i. e., the hypotheses of signal absence or presence are tested. With allowances for real rather than ideal conditions, the results indicate an immunity of a rank detector with interperiodic filtration to interference which is nonstationary during the reference-sampling interval. When the probability of interference pulses coinciding with elements of distance resolution is low, then the detection characteristics of such a device are almost the same as without interference. A higher flux density of random interference pulses causes the threshold signal level to rise and thus the intraperiodic processing to become too "stiff." Figures 2; references: 1 Russian (?).

[270-2415]

## CONCERNING THE PROBLEM OF SIMULTANEOUS MEASUREMENT OF THE ANGLE PARAMETERS OF SEVERAL SIGNALS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1226-1230 manuscript received 22 Jun 77

FAL'KOVICH, S. YE. and SHKVARKO, YU. V.

[Abstract] The general deterministic approach to synthesis of algorithms for simultaneous measurement of the angular coordinates of signals from many targets is compared for potentially realizable accuracy characteristics with the statistically optimum approach. The results show that



the general deterministic approach to the problem of simultaneous measurement of the angular coordinates of sources of radiation against a background of fluctuation noises in the case ( $|E_p|^2 T / 2N_0 \gg 1$ ) is equivalent to the procedure of optimum estimation of angles by the method of maximum likelihood, assuming preliminary matched filtration of waveforms received by the antenna elements. Here  $E_p$  is the complex amplitude of the signal from the p-th target, and  $N_0$  is the spectral density of white noise. Figures 1; references 7: 5 Russian; 2 Western.

[244-6610]

USSR

UDC: 621.391.8

# ASYMPTOTIC EFFECTIVENESS OF SIGNAL DETECTION USING EXTREMAL STATISTICS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1224-1226 manuscript received 19 Apr 77

VASIL'YEV, K. K.

[Abstract] The optimum algorithm for detection of signals with random amplitude from a sample  $\{x_j\}_{j=1}^N$  of the envelope of the input process is based on the statistic

$$T_s = \sum_{j=1}^N x_j^2.$$

In this paper, a procedure is considered that uses the extremal statistics

$$T_s = \sum_{i=1}^m \sup_j x_j^2 \begin{cases} > \gamma & \text{there is a signal} \\ < \gamma & \text{there is no signal} \end{cases}$$

where  $\sup_j x_j^2$  is the square of the greatest reading of the i-th group  $\{x_j\}_{j=(i-1)n+1}^{in}$  ( $i = 1, 2, \dots, m$ ) into which the sample  $\{x_j\}_{j=1}^N$  is divided, the number of elements in a group  $n = N/m$  being an integer by definition, and  $\gamma$  is a constant quantity determined from the given false alarm probability. Approximate formulas are derived that can be used for computer calculations of the asymptotic relative effectiveness when  $n$  is large:

$$\rho \approx \gamma^2 / n(2 - (C - \gamma/2n)) \quad \text{or} \quad \rho \approx (0.58 + \ln n)^2 / 1.67n,$$

where  $\phi = \sum_{i=1}^n (i)^{-1}$ , and  $C$  is Euler's constant. References: 3 Russian.

[244-6610]

USSR

UDC: 621.391.8:621.391.82

OPTIMUM RECEPTION WITH ARBITRARY FLUCTUATIONS OF INTERFERENCE AND SIGNALS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 5, 1979 pp 1082-1086 manuscript received 23 May 77

CHABDAROV, SH. M.

[Abstract] The case of signal reception under the influence of various flows of chaotic pulsed interference (KhIP) is considered for arbitrary probability densities of relative fluctuations of amplitudes of useful and interfering radio pulses having complex envelopes, against a background of noise with uniform spectral density. In the interesting cases, the net flow of KhIP is regular, random initial phases are equally probable and amplitude fluctuations of signal pulses and interference are always represented by polyRice densities of dimensionless coefficients. When a signal with an unknown appearance time is detected, realization of the proposed algorithm is associated with quantization of the set of analyzed moments of appearance of KhIP and the use of multiple-tap delay lines. Figures 3; references: 6 Russian.

[230-8617]

USSR

UDC: 621.391.16

EXPERIMENTAL VERIFICATION OF THE STATIC CHARACTERISTICS OF SERIES ANALYZERS

Moscow RADIOTEKHNIKA, Vol 34 No 6, Jun 79, pp 50-51

SKVORTSOV, V. S.

[Abstract] In a previous work by the author (RADIOTEKHNIKA, 1977, Vol 32, No 3), for two forms of discrete series statistic analyzers, which achieves two resolving instructions, formulas are obtained for the calculation of the operating characteristic (OKh) and the average number of observations (SChN) as explicit functions from the parameter of distribution  $p$  of a Bernoulli sequence. The present work is concerned with an experimental verification of OKh and SChN of analyzers, which achieves the resolving instructions, a comparative evaluation of them and a comparison of data and experimental calculations. Figures 2; references: 2 Russian.

[254-6415]



SYNTHESIS OF RADIO ENGINEERING TRACKING-MEASURER, OPTIMUM WITH RESPECT TO THE CRITERION OF THE MAXIMUM RELIABILITY OF NONAPPEARANCE OF ERROR FROM A SPECIFIED REGION

Moscow RADIOTEKHNIKA, Vol 34, No 6, Jun 79, pp 68-71 manuscript received after completion, 13 Jul 78

MEL'NIKOV, B. G.

[Abstract] With a high precision of measurement of the parameters of motion of an object it is possible to employ a Gaussian approximation of the posteriori law of the distribution, and synthesis of radio engineering tracking measures leads to two independent problems: synthesis of an optimum discriminator and synthesis of an optimum ripple filter. In so doing, from the point of view of its precision properties, it is possible to consider a nonlinear tracking measurer as a linear nonstationary ripple filter, the elements of the vector of the input effect of which in the general case are mutually correlated. The present paper considers the problem of synthesis of a linear ripple filter of a radio engineering tracking measurer, optimum with respect to the criterion of the maximum probability of the nonappearance of filtering errors from a specified region. Figures 2; references: 4 Russian.

[254-6415]

ADAPTIVE SELECTION OF OPTIMUM CODING SYSTEMS

Moscow AVTOMATIKA I TELEMEXHANIKA in Russian No 4, 1979 pp 117-120 manuscript received 26 Apr 78

DYN'KIN, V. N. and ZHIROV, M. V., Moscow

[Abstract] A new approach is proposed to solution of the problem of raising reliability of information in data transmission systems. The method is based on using a group of coding systems and adaptive control of these systems in order to select the coding system that ensures the necessary reliability of information in the transmission channel at the maximum rate of transmission. Realization of this approach has a number of features in common with adaptive coding systems. Two problems are formulated and solved on optimizing the selection of coding systems. These solutions enable determination of optimum strategies that indicate rules of selection of coding systems in each test. References 4: 3 Russian, 1 Western.

[256-6610]

## TRANSMISSION OF A GROUP SIGNAL THROUGH A DEVICE WITH IDEAL LIMITING

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1216-1219 manuscript received 14 Apr 77

DEYEV, V. V.

[Abstract] The author considers the problem of group signal transmission through a device of the limiter type in which the amplitude response is a step function with a given saturation threshold. The individual components of the output process are found when any number of signals with arbitrary power ratio arrive at the input of the limiter, and in particular when some signals are higher in amplitude level than the rest, so that the group signal cannot be considered a normal process. An expression is found that can be used as the basis for a technique for calculating the levels of isolated signals and combination components at the output. Analysis by such a technique shows that when several signals of different levels pass through the limiter, certain combination components appear at the outlet that are essentially weak signals with respect to power. The power ratio of the weak signal and combination component at the output can be increased by transmitting an additional signal to the limiter input that gives a quasilinear amplitude response for weak signals. Figures 4; references 7: 4 Russian, 3 Western.

[244-6610]

## ON SOME PROPERTIES OF WAVE SYSTEMS WITH NON-STATIONARY BOUNDARIES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 5, 1979 pp 990-999 manuscript received 12 Sep 77

VESNITSKIY, A. I. and POTAPOV, A. I.

[Abstract] Wave systems with variable parameters are of great interest because of the growing needs of modern technology for new, more efficient methods of transformation, amplification and generation of signals in the shf (microwave) range. There are three classes of distributed systems: 1) systems with distributed parameters variable in time and space; 2) systems with mobile boundaries; and 3) systems with stationary boundaries whose parameters vary in time. An example of the type 3) system are sections of long lines (resonators) loaded onto discrete elements. They may be manufactured from mass-produced components: strip or coaxial

lines, concentrated varicaps, tunnel diodes, capacitors, inductors, etc. The method of analog simulation is used to make a general approach to the study of this class of systems. At this stage, analog simulation seems to be the most efficient method of studying multiple frequency modes of oscillation: it can reveal the basic qualitative aspects of wave behavior, including the allowance for nonlinear properties of the boundaries. Simulation can also aid in finding the most efficient analytical methods of studying these systems. In view of the good coincidence of the results of computerized experimentation and full-scale tests, analog simulation can be fully recommended as one of the methods of planning and calculation of specific microwave devices. Figures 6; references: 15 Russian.

[230-8617]

USSR

UDC: 621.372.54.037.372

#### FIRST-ORDER DIGITAL PHASE-LOCK LOOP DIFFERENTIAL EQUATIONS AND DYNAMICS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 5, 1979 pp 958-964 manuscript received 29 Nov 77

BELYKH, V. N. and MAKSAKOV, V. P.

[Abstract] The digital system of phase synchronization (TsSFS) of the first order with binary quantization for synchronization of radio signals (harmonic) or video signals (meandering, pseudonoise) was investigated. This system was studied under conditions of non-zero initial frequency detuning, various forms of signal and various methods of quantization. The current quasi-continuous analytic method of TsSFS enables us to derive approximate formulas for statistical characteristics of the system if external noises are greater than internal ones. More accuracy investigation of TsSFS can be carried out on the basis of the theory of discrete Markov processes (TDMP) in the presence of noise and the method of point reflections (MTO) in the absence of noise. This study utilized TDMP and MTO to analyze the derived mathematical model in the form of a system of functional-differential equations. Figures 3; references 13: 11 Russian, 2 Western.

[230-8617]

## F ST-ORDER DIGITAL PHASE-LOCK LOOP STATISTICAL DYNAMICS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 5, 1979 pp 965-974 manuscript received 29 Nov 77

BELYKH, V. N. and MAKSAKOV, V. P.

[Abstract] The probability model of a digital system of phase synchronization (TsSFS) of the first order proposed by Holmes is investigated. The Markov process of change of the system's phase coordinate is simulated by equations which determine the change in phase probability density at times  $j = km$  (instants of appearance of control pulses) and  $j \neq km$  (intervals between them). Complex behavior of steady-rate motions without noise and probability density with noise present is possible; steady-state processes may be a function of initial conditions associated with system discreteness. Figures 4; references 11: 9 Russian; 2 Western.

[230-8617]

## CALCULATION OF A "MEANDER" TYPE DELAY SYSTEM

Moscow RADIOTEKHNIKA, Vol 34 No 6, Jun 79, pp 17-22 manuscript received after abridgement, 9 Nov 78

LOSHAKOV, L. N. and DZUGAYEV, V. K.

[Abstract] Most of the work in a calculation of the "Meander" type delay system used in radio engineering equipment and microwave electron devices is carried out on the basis of the method of multiple lines. Such a method of calculation makes it possible to obtain results acceptable in practice in the case of a line large in comparison with the period of the length of the transverse conductors. The method of multiple lines had been combined with the use of certain relationships of field theory; however, an approximation of type TEM waves along the transverse conductors is also used. The present paper describes a method of calculation of the dispersion characteristics of a "Meander" type system by a solution of the equations of an electromagnetic field in an elliptical cylindrical system of coordinates, which in principle is free from the limitations of the method of multiple lines mentioned above. It is shown that the method of calculation described can be used for analysis of "Meander" type delay systems. Figures 3; references 7: 6 Russian; 1 Western.

[254-6415]

## PRINCIPLES OF CONSTRUCTION AND NOISE IMMUNITY OF MULTIPHASE SELF-CORRELATED SIGNAL DEMODULATORS WITH PHASE DIFFERENCE MODULATION OF THE SECOND ORDER

Moscow RADIOTEKHNIKA, Vol 34, No 6, Jun 79, pp 11-16 manuscript received 10 May 78

OKUNEV, YU. B., PISAREV, V. A. and RESHEMKIN, V. K.

[Abstract] Possible means of constructing demodulators of signals with phase difference modulation of the second order (FRM-2) are considered. The principle of construction of a multiphase demodulator intended for radio communication systems with unstable frequency is presented. The results obtained, as compared with the noise immunity of systems with phase difference modulation of the first order (FRM-1) and FM, make it possible to conclude that: invariant multiphase self-correlated demodulators of signals with FRM-2 with an arbitrary signal relatively surpass, with respect noise immunity, an optimum noncoherent demodulator of signals with FM and are very slightly inferior to an optimum noncoherent demodulator of signals with FRM-1 during operations of the latter under conditions of precisely known frequency. The authors thank M. Ya. Lesman and L. G. Rozenblat for assistance in calculations. Figures 4; reference: 11 Russian.

[254-6415]

## SENSITIVITY OF OPTIMUM ANALYZERS WHICH EXTRAPOLATE NOISE CONDITIONS TO CORRELATED RADIO INTERFERENCE PROPERTIES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 5, 1979 pp 940-944 manuscript received 16 Sep 77

KOVESHNIKOV, V. G. and SHAROV, A. N.

[Abstract] To ensure stable radio communications in the decameter range, it is necessary to have continuous reliable information on current and predicted noise environments so that during disturbed communication periods, it is possible to re-tune the radio line to those analyzed frequencies where the current or predicted noise level is minimum. Analyzer-extrapolators of noise levels (signals) assuring potential accuracy of evaluation and prognosis can be synthesized on the basis of methods of the theory of state variables. But there are problems, mainly those associated with selection of a mathematical model and assignment of the

vector of states of the evaluated noise (signal). Analysis of sensitivity of these analyzers of the noise environment which extrapolate to correlation properties of actual radio interference permits a general conclusion to be drawn about the advisability of inserting an automatic tuning circuit for the appropriate parameters of the model, in order to achieve high accuracy of measurement and prediction. Figures 2; references: 5 Russian.

[230-8617]

USSR

UDC: 621.396

# INTERFERENCE IN ASYNCHRONOUS ADDRESS COMMUNICATION SYSTEMS OPERATING IN FREE SPACE

Moscow RADIOTEKHNIKA in Russian Vol 34, No 7, Jul 79 pp 55-57

KITAYEVA, V. K.

[Abstract] The ratio of signal to total interference at a receiver operating with an array of ultrashort-wave surface transmitters at various distances  $r$  from it was determined earlier, in that case the signal power being proportional to  $1/r^4$ . Here this ratio is determined for an aerospace system of communication satellites operating in free space, where the signal power is proportional to  $1/r^2$  and the interference power can increase infinitely with increasing density of transmitters. First the interference power is calculated by the method of concentric zones around the reception circle, with averaging and summing, this power increasing logarithmically as the number of zones increases. Then the power of the useful signal coming to the receiver from the farthest transmitter is calculated and, on this basis, the minimum signal-to-interference ratio. Finally, an optimal receiver with a corrector or a matched filter is taken into consideration with a transmitter randomly located within the main zone and interfering transmitters outside it. Figures 2; references 8: 3 Russian, 5 Western.

[270-2415]



USSR

UDC: 621.396.22.029.7

# ALGORITHM OF ESTIMATING THE ANGULAR COORDINATES OF A PULSE SOURCE OF QUANTUM RADIATION

Moscow RADIOTEKHNIKA in Russian Vol 34, No 7, Jul 79 pp 76-78 manuscript received 6 Jan 78

POZHARSKIY, A. V.

[Abstract] A pulse source of quantum radiation is considered and an instrument is synthesized which measures the angular coordinates of this source, with the aid of a 4-pad photodetector operating as a photoelectron counter. Into account are taken the misalignment angles in two planes between the optical axis of the instrument and the direction to the center of the source, the surface area of any one photodetector cell, and the distribution of light intensity in the photodetector plane. With the background light intensity assumed to be uniform within the radiation pattern, the synthesis of the instrument is based on the method of maximum similarity and subdivision of the entire counting period in each of  $j$  photodetector cells into  $i$  intervals of length  $\Delta t$ . The estimate of the angular coordinates is obtained in terms of respective mathematical expectations, the accuracy of this estimate is established, also the intensity of background radiation without a signal present is estimated. Together the total detection algorithm is constructed, which must include weighting factors. References: 4 Russian.

[270-2415]

USSR

UDC: 681.84.087.7

# EVALUATION OF TECHNICAL COMPATABILITY OF A STEROPHONIC SYSTEM WITH QUADRATURE MODULATION

Moscow RADIOTEKHNIKA, Vol 34, No 6, Jun 79, pp 37-39 manuscript received 1 Aug 77

YEFIMOV, A. P. and SASAROV, V. I.

[Abstract] In the majority of cases technical compatability of stereophonic and monophonic systems is achieved by use of the add-subtract method of transmission of the stereophonic signal. In so doing rigorous requirements are imposed on the unbalance of the amplitude-frequency and phase-frequency response of the channels by which the sum and difference of the stereo pair are transmitted. In wire broadcasting this is easily achieved during transmission on one carrier. It is advisable to consider the compatability of a system with amplitude modulation (AM) of the

carrier by two signals in quadrature. It is possible in a first approximation to take into account the frequency properties of a network of wire broadcasting for each channel of such a system, as for a system with AM. However, the principal cause of distortions during reception of a monophonic subscriber's device with a linear detector characteristics is the effect of a quadrature channel on the cophasal. Expressions are obtained in the present paper for the harmonic distortion factor and the dissipation factor during linear detection of a quadrature modulated signal. Figures 2; references: 6 Russian.

[254-6415]

USSR

#### PROGRESS IN OPTICAL COMMUNICATIONS

Riga NAUKA I TEKHNIKA in Russian No 4, 1979 pp 28-29

KYUZAN, MARK PETROVICH, Senior engineer, Design Bureau, VEF (Riga Order of Lenin State Electrotechnical Plant imeni V. I. Lenin)

[Abstract] The author reviews the development of optical transmission lines using coherent sources of light and optical fibers. Because of small wave-length and large bandwidth, optical lines can handle many more communication channels than conventional transmission systems. Intrafacility lines are presently most highly developed, but work is progressing on municipal and long-range lines. Examples are given of recent development in the United States, Great Britain and Japan. A diagram is given illustrating present and future optimization of wide-band data transmission.

[258-6610]

USSR

A COMMENT ON ONE STATEMENT IN THE ARTICLE BY V. V. GINZBURG 'PROCEDURES FOR ON-THE-WHOLE RECEPTION OF SIGNALS WITH REDUNDANCY' (RADIOTEKHNIKA Vol 33, No 11, Nov 78)

Moscow RADIOTEKHNIKA in Russian Vol 34, No 7, Jul 79 pp 88-89

ZLOTNIK, B. M.

[Abstract] B. M. Zlotnik disagrees with the statement that "unfortunately,



constant-weight codes are not good ones: the minimum Hamming distance for them is only 2", on the following grounds: 1) A minimum Hamming distance of 2 is found in only narrow subclasses of such codes; 2) an infinitely wide class of constant-weight binary codes with a distance larger than 2 is known, simplex codes being "outstanding" in terms of noise immunity; 3) orthogonal and biorthogonal codes are structurally constant-weight codes with an added "1" or "0" word respectively; 4) constant-weight codes must be defined as codes containing in each word a constant number of symbols of each value; 5) constant-weight codes are now among the few ones admitting a nonexponential increase of complexity of on-the-whole decoding as the code becomes longer. V. V. Ginzburg agrees with this criticism and points out that his statement was made only in reference to the feasibility of on-the-whole reception by procedures of integral-numbers nonlinear programming. It should, indeed, be possible to construct constant-weight codes in which reception by such procedures is realizable, but V. V. Ginzburg has found nothing about such codes in the published literature on this subject. At the same time, V. V. Ginzburg also points out a few misprints in the original article. References 7: 6 Russian, 1 Western.

[270-2415]

USSR

UDC: 535.3:681.7.068

DESIGN OF QUASI-UNIMODAL OPTICAL FIBERS WITH A SELECTIVELY REFLECTING MULTI-LAYER COATING

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1282-1290 manuscript received 31 May 78

MANENKOV, A. B. and MELEKHIN, V. N.

[Abstract] Problems due to crowding of modes in optical fibers are largely overcome with hollow multilayer dielectric tubes or selectively reflecting layers around a glass filament. Such waveguides transmit essentially egressing rather than surface waves as signal carriers and parasitic higher modes of these are fast attenuated by radiation. The dielectric permittivity of an outer layer is preferably lower than that of the glass core. This requires a layer sufficiently thin to allow tunneling of the light beam to the inner layers, but it also allows for wider tolerances on the layer thickness. Design and performance calculations for such multilayer structures are based on a solution of Maxwell field equations and subsequent collocation of fields at the layer boundaries. Here calculations are made for circular cylindrical fibers with four layers around the core. Of fundamental importance is the dependence of the attenuation coefficients for all significant modes on the wavelength and on the thicknesses of the critical first two layers. The results can be compared with the results of computer-aided impedance and admittance calculations. The authors thank P. L. KAPITSA for the interest in this study and L. A. VAYNSHTEYN for the discussion of it. Figures 4; references 11: 7 Russian, 4 Western.

[273-2415]

USSR

UDC: 621.327.8.001.24

NATURAL MODES IN DIELECTRIC WAVEGUIDES OF INTRICATE CROSS SECTION (SURVEY)

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1245-1263 manuscript received 29 Dec 78

VOYTOVICH, N. N., KATSENELENBAUM, B. Z., SIVOV, A. N. and SHATROV, A. D.

[Abstract] The mathematical analysis of dielectric waveguides with arbitrary cross sections and with arbitrary distributions of dielectric permittivity over the cross section is surveyed here. Surface waves slowly propagating along such waveguides are considered, the analysis of which essentially involves solutions to homogeneous Maxwell field equations. The analysis is based on the general theory of natural modes and the description of

waves in transverse rather than longitudinal components. The reason for this preference is that, with any of the pairs of scalar potentials  $E_x(x,y)$  and  $E_y(x,y)$  or  $H_x(x,y)$  and  $H_y(x,y)$ , rather than the conventionally used pair  $E_z(x,y)$  and  $H_z(x,y)$ , the eigenvalue of the homogeneous problem, i.e., the wave number appears only in the differentiation operator and not in the boundary conditions. Calculations are generally performed by applying the variational apparatus to a field functional stationary in the solutions to the problem. The dielectric permittivity can either vary continuously over the cross section or so that an interface between dielectrics results. In the case of a symmetric distribution the field variables are separable and in the homogeneous case the problem reduces to standard integrodifferential equations. The properties of waves are further examined in various asymptotic situations: a small gradient of dielectric permittivity, with any degeneracy preventing linear polarization, and high or low frequencies respectively far or low from the critical frequency for a given low-order mode. A typical application here are multimodal homogeneous waveguides of arbitrary cross section, and the method of analysis can be extended to stripline waveguides. Near the critical frequency both the dispersion equation and the integrodifferential field equation need to be solved. Of interest are two relations, consequences of the Laplace equation, characterizing the two longitudinal field components outside a waveguide. Figures 7; references 24: 19 Russian, 5 Western.

[273-2415]

USSR

UDC: 621.372:621.318.134.029.64

# DIRECT COUPLING BETWEEN FERRITES IN A TWO-SECTIONAL FILTER ON ORTHOGONAL TRANSMISSION LINES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1442-1444 manuscript received 5 Nov 77

ROGOZIN, V. V. and FADEYEV, A. O.

[Abstract] The frequency characteristic of the transmission coefficient for a two-sectional filter on orthogonal transmission lines with ferrites approaches that for a one-sectional filter as the lengths of the transmission lines decrease toward zero, but only when direct coupling between the ferrites is disregarded. This coupling becomes stronger, however, as the distance between them decreases. Here this coupling is taken into account in the case of ellipsoidal ferrites one in each section. The transmission coefficient and its frequency characteristic are calculated from field and wave coefficients for ferrites excited by a magnetic field

and for transmission lines with short circuits at the ends. The resulting expression becomes the same, with the lengths of the transmission lines decreasing to zero, as that for a two-sectional filter with indirect coupling between the ferrites. Figures 2; references: 2 Russian.

[273-2415]

USSR

UDC: 621.372.8.001.24

#### CALCULATION OF COMPLEX CROSS-SECTION WAVEGUIDES BY THE LEAST-SQUARES METHOD

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 5, 1979 pp 1058-1060 manuscript received 1 Aug 77

VOYTOVICH, N. N.

[Abstract] Recently several numerical methods have been proposed for calculation of intrinsic waves of dielectric waveguides of complicated cross section: the method of integral equations, different versions of variational analysis, etc. These methods were compared to determine which is most promising. The least-squares method is better than other variational methods: the dimension of the system of basis functions is reduced. This merit shows up mainly when calculating the lowest waves in a low-mode waveguide. It is completely unacceptable for calculating multimodal waveguides. Lowest waves in systems with three or more section axes of symmetry are degenerated: this is attributed to the invariance of geometry of the section with respect to rotation through some angle. For all forms of section there is a reduction of intensity of the field at acute angles: this fact can be used to reduce losses with longitudinal attachment of a waveguide of complex profile. Figures 2; tables 1; references 6: 3 Russian, 3 Western.

[230-8617]

USSR

UDC: 621.318.134.029.64

#### MICROWAVE SIGNAL MIXING IN A FERRITE-SEMICONDUCTOR STRUCTURE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1979 pp 1031-1035 manuscript received 5 Jul 78

VASHKOVSKIY, A. V.: ZUBKOV, V. I.: KIL'DISHEV, V. N.: STAL'MAKHOV, A. V. and TEMIROV, YU. SH.

[Abstract] The development of integrated technology of microwave frequencies

permits the study of new planar designs for ferrite devices, especially microwave signal mixers. In making a mixer planar, it is necessary to select the shape of the ferrite specimens in the form of a disk or plate placed on the same board as other planar microwave elements. Magnetization perpendicular to the board (and ferrite specimen) is preferable, but then  $N_z$  is roughly equal to unity and the amplitude of the difference frequency signal in the coil is small because it is proportional to  $(1 - N_z)$ . In tangential magnetization, the structures  $N_z = 0$ , but the inductance coil must intersect the plane of the board. A new principle of isolation of the difference frequency signal is called for to design a planar mixer, e.g., a ferrite-semiconductor structure. Transformation losses were 10-12 dB lower than usual at identical heterodyne output. Transformation losses can be reduced even more by selecting a semiconductor with a greater Hall constant. The dynamic range of the mixer can be increased by taking a ferrite specimen with a small ratio of diameter to thickness. The frequency band and dynamic range of this kind of mixer can be increased by using ferrites with a wider line of ferromagnetic resonance, e.g., a polycrystalline ferrite. It also has a higher threshold of parametric excitation of spin waves. Figures 3; references 15: 13 Russian, 2 Western.

[230-8617]

USSR

UDC: 621.372.8.029.7

#### ON GEOMETRIC OPTICS OF HIGH-APERTURE NONCIRCULAR HOMOGENEOUS FIBERS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 5, 1979 pp 1055-1057 manuscript received 6 Jul 78

FEL'D, S. YA.

[Abstract] High-aperture optical fibers have small losses in aligning with LEDs and bend losses; a reduction of these losses in not too long segments of fiber offsets the possible increase in thermal losses because an increase in the optical path of beams propagating at large angles to the fiber axis, and an increase in losses with reflection against the envelope. When an extensive light-guide is being constructed, the fibers must be attached and protected to obviate an increase in energy loss resulting from permeation of part of the power into the protecting envelope. A possible solution is to use fibers having a cross-section other than round: the field is concentrated near the center of section and will not penetrate into the projecting areas. In the beam approximation in an elliptical section, families of caustic curves are formed as ellipses and hyperbolas cofocal to the initial ellipse. A lenticular form, i.e. an ellipses and hyperbolas cofocal to the initial ellipse. A lenticular form,

i.e. an ellipse which has transcaustic curves deformed to produce projections for attachment of the fiber to the envelope, realizes an optical fiber with high numerical aperture and small losses due to leakage of energy through supports. Light-guides of elliptical section are also of interest. Lower types of waves do not penetrate into the tapering regions of the light-guide. The author thanks B. Z. Katsenelenbaum for guidance of the work. Figures 3; references: 5 Russian.

[230-8617

USSR

UDC: 621.372.8.001.24

SHORTWAVE ASYMPTOTIC FORM OF THE PROBLEM OF DIFFRACTION ON THE OPEN END OF A FLANGED WAVEGUIDE. SCATTERING PATTERN

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1036-1042 manuscript received 13 Apr 77

KHESTANOV, R. KH.

[Abstract] In a previous paper the author solved the problem of radiation from the open end of a flanged waveguide ["Radiotekhnika i elektronika," Vol 24, No 6, 1979 p 1027]. The scattered field was represented as the sum of two integrals for plane wave diffraction. The angle spectra of the two integrals are the directional patterns of the edge waves. A singular integral equation was derived for the directional patterns, and the solution was reduced to solution of a Fredholm's equation. In this paper, recursive formulas are derived for the shortwave asymptotic expansion of this diffraction problem, and the radiation and scattering patterns are expressed in terms of known formulas based on the example of one-term and two-term asymptotic expansions. The results can be used in designing waveguide configurations that incorporate the open end of a flanged waveguide. References: 4 Russian.

[244-6610]



## TRUNCATED WAVEGUIDE CORNER IN THE H-PLANE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1043-1052 manuscript received 18 Jul 78

KIRILENKO, A. A., LITVINOV, V. R. and RUD', L. A.

[Abstract] A detailed analysis is made of a classical waveguide component, a truncated H-plane corner. Precise calculation of these components is complicated by the presence of irregular triangular regions, sharp edges and so forth. In this paper a rigorous solution is found for problems of diffraction of  $H_{p0}$  waves on a truncated corner by reducing the boundary value problem to a system of linear algebraic equations and using a semi-inversion technique to calculate the scattering matrix. On the basis of this solution, the electrodynamic characteristics of a truncated waveguide corner are studied and optimized in the single-mode region. It is shown that within certain limits the geometric parameters can be taken off-optimum to extend the matching band. Deviations from optimum geometry have the greatest influence on phase characteristics at the edges of the working band, the phase shifts being more noticeable for sharp corners. Figures 4; references 17: 11 Russian, 6 Western.

[244-6610]

## CHARACTERISTICS OF A TRUNCATED MULTIMODE WAVEGUIDE CORNER IN THE H-PLANE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1053-1060 manuscript received 7 Aug 78

KIRILENKO, A. A., LITVINOV, V. R. and RUD', L. A.

[Abstract] In an earlier paper, these authors used an efficient numerical algorithm for detailed analysis and optimization of the amplitude and phase frequency responses of truncated waveguide corners in the single-mode region ["Radiotekhnika i elektronika," Vol 24, No 6, 1979 p 1043]. In this paper the multimode case is considered. The analysis is based on the solution and algorithm derived in the earlier work on the basis of the technique of semi-inversion. The proposed method eliminated restrictions on the geometry of the nonhomogeneity, and can be used for calculations in the resonant region right up to quasi-optical frequencies. An analysis is made of the influence that the position of the plane of truncation has on the characteristics of waveguide corners in the multimode region. It is shown that truncated corners in multimode operation cannot transmit

the incident wave without losses to reflection and conversion, in contrast to the single-mode region. It is also found that such truncated reflectors have a weak level of wave mode filtration. Characteristics of corners with quasi-optical truncation are compared with asymptotic estimates. Figures 5; references 11: 7 Russian, 4 Western.

[244-6610]

USSR

UDC: 621.372.8.09

#### THRESHOLD PHENOMENA IN WAVEGUIDE SYSTEMS

Gor'kiy IZV VUZ: RADIOFIZIKA in Russian Vol 22, No 6, 1979 pp 750-753  
manuscript received 25 Jul 78

AYBVAZYAN, YU. M., All-Union Scientific-Research Institute of Physico-technical and Radiotechnical Measurements

[Abstract] When plane electromagnetic waves are diffracted by periodic structures, characteristic singularities called Wood anomalies arise on the threshold of formation of a spectrum of a new order in spectra of already existing orders. It is shown in this paper that analogous threshold effects inevitably arise when electromagnetic waves propagate in waveguide connectors, no matter how complicated they may be. The analysis is based on a system of an arbitrary number of regular waveguides interconnected by a junction where it is assumed that there is no energy dissipation or frequency conversion. These threshold anomalies should also arise for waves in dielectric and acoustic waveguides, as well as in optical waveguides (light guides). The author thanks B. M. Bolotovskiy for interest in the work and discussion of the results. Figures 1; references 5: 4 Russian, 1 Western.

[251-6610]

USSR

UDC: 621.372.8.001.24

#### DIFFRACTION ON THE OPEN END OF A FLANGED WAVEGUIDE. REGULARIZATION OF THE INTEGRAL EQUATION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1027-1035 manuscript received 13 Apr 77

KHESTANOV, R. KH.

[Abstract] The author considers the two-dimensional problem of diffraction

on the open end of a waveguide with a symmetric flange, and finds a solution for Dirichlet and von Neumann boundary conditions with symmetric and anti-symmetric excitation. The pattern of the scattered field of one of the wedges that form the open end of the flanged waveguide is represented as the sum of the pattern of the diffraction field of the primary plane wave and the pattern of the diffraction field of the wave emanating from the other wedge. The resultant integral equation is regularized by the Wiener-Hopf transform technique. It is shown that the solution of the boundary value problem is given by the sum of the primary and scattered fields. Expressions in the form of sums of multiple integrals with smooth kernels are suitable for numerical integration. Figures 2; references 6: 4 Russian, 2 Western.

[244-6610]

USSR

UDC: 621.372.8.029.7

#### REDUCTION OF PULSE DISPERSION IN A MULTIMODE FIBER BY DEGENERATED MODE COUPLING

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1979 pp 1061-1063 manuscript received 15 Dec 78

SHATROV, A. D.

[Abstract] The passage of a pulsed signal through a multimodal irregular fiber with small deviations of the index of refraction from its unperturbed value is examined. The fiber has an abundant spectrum of aximuthal irregularities and the fiber's properties change smoothly along the  $z$  axis. Under these conditions, power exchange will mainly occur among modes with similar constants of propagation. The model where a group of almost degenerated modes is being propagated through the fiber becomes probably. Mixing within each group is intense, but the groups does not interact with each other. Because of intense mixing, power is distributed uniformly through the degenerated modes. The families of distribution  $n(r)$  with linear and parabolic troughs are graphically illustrated.

Note: When this paper was already in type, the author became acquainted with the work of K. Petermann, 4th European Conference on Optical Communications, Geneva, 1978, Paper V. 4 in which similar results are reported without a conclusion. Figures 3; references 2: 1 Russian, 1 Western.

[230-8617]

## AUTONOMOUS MULTIMODE BLOCKS AND THEIR USE FOR STUDYING A STRIP LINE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1070-1077 manuscript received 11 Sep 78

NIKOL'SKIY, V. V. and GOLOVANOV, O. A.

[Abstract] The decompositional approach to electrodynamics problems, and specifically to problems of stripline structures, has lately found reflection in the method of minimum autonomous blocks [MAB]. These blocks are constructed so that when their dimensions are sufficiently small, one is justified in considering only fundamental waves of two polarizations of type T. Multi-dimensional blocks in the form of parallelepipeds with virtual channels of the conventional rectangular waveguide type have not yet been made in a practical form. Nevertheless, there is a certain class of problems in which the use of multimode autonomous blocks [AMB] should be advantageous. In this paper the author derive initial expressions necessary for the use of autonomous multimode blocks, and show that these blocks are effective in analyzing a regular strip line with conductors of finite thickness. The authors thank A. V. Druzhinin who prepared certain computations used in the paper. Figures 8; references 10: 8 Russian, 2 Western.

[244-6610]

## A DIGITAL BANDPASS FILTER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 pp 97-100 manuscript received 17 Feb 78

GORSHKOV, A. K., LESNIKOV, V. A., PETROV, YE. P. and CHASTIKOV, A. V.,  
Kirov Polytechnical Institute

[Abstract] The authors consider a version of combinatorial realization of a digital bandpass filter with transfer function  $H(Z) = AZ^2/(Z^2 - b_1Z - b_2)$ , where  $A$  is a scaling factor that is a power of 2. Operation of a digital filter with this transfer function is described by the difference equation  $Y_n = AX_n + b_1Y_{n-1} + b_2Y_{n-2}$ , where  $X_n$  and  $Y_n$  are the  $n$ -th readings of the input and output sequences respectively, and  $b_1, b_2$  are coefficients. It is assumed that  $X_n$  and  $Y_n$  are represented by  $Q$ -place auxiliary codes. Simple transformations reduce the difference equation to the form  $Y_n = AX_n - \beta_0 + \sum_{j=1}^{Q-1} \beta_j 2^{-j}$ , where  $\beta_j = b_1Y_{n-1}^j + b_2Y_{n-2}^j$ . In this expression,

$y_{n-1}^j$  and  $y_{n-2}^j$  are the values of the  $j$ -th places in the  $Q$ -place output readings  $y_{n-1}$  and  $y_{n-2}$ . The proposed filter operates without explicit multiplication. The working frequency band of the filter depends on the speed of the microcircuits used. A block diagram is given of a filter for  $Q=8$  and  $A = 2^{-7}$ , and time diagrams are given for operation relative to clock pulses. Experimental curves are given showing the width of the passband as a function of the coefficients  $b_1$  and  $b_2$ . Figures 4; references 3: 1 Russian, 2 Western.

[261-6610]

USSR

UDC: 621.372.832

# COMPUTER-AIDED SYNTHESIS OF OUT-BAND RADIATION FILTERS ON THE BASIS OF CLASS-2 NOTCHING DIRECTIONAL COUPLERS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1440-1442 manuscript received 10 Aug 77

KATS, B. M. and MESHCHANOV, V. P.

[Abstract] Symmetric notching directional couplers can be used as filters of out-band radiation. Here a computer-aided synthesis of such filters with Class-2 notching directional couplers is shown which involves numerical methods of nonlinear programming. The problem of synthesis on the basis of the Chebyshev optimality criterion is formulated as a minimax problem with a constraint on the attenuation within the pass band and on the rejection level. The problem is solved by iteration, with the electrical lengths of coupled and uncoupled line segments as well as the coupling coefficient varied. The optimum parameter values are tabulated and the crosstalk attenuation characteristic is plotted graphically for  $m = 5$ ,  $L = 3$  and for  $m = 9$ ,  $L = 4$ . Figures 2; tables 1; references: 4 Russian.

[273-2415]

## A MINIATURE FILTER BASED ON AN EVANESCENT WAVEGUIDE WITH A DIELECTRIC

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 pp 145-147 manuscript received 16 Jan 78

BERGER, M. N., KAPILEVICH, B. YU. and SIMIN, N. S., Novosibirsk Electrical Engineering Institute of Communications

[Abstract] Previous research has dealt with resonance phenomena in evanescent waveguides loaded by a dielectric layer. Such structures can be used in making miniature frequency-selective microwave devices. This paper gives the results of a study of resonance elements based on evanescent waveguides with symmetric dielectric filler, and also stripline filters that utilize such elements. The resonant component in such filters is a rectangular evanescent waveguide section with symmetrically arranged dielectric layer. Rectangular waveguides that propagate a fundamental wave of mode  $H_{10}$  are connected to the input and output of this section. A typical two-element strip filter in the 9-12 GHz band has a insertion loss of about 1 dB in the passband, and more than 30 dB outside of the passband. The VSWR of the filter is 1.2 or less when connected to a waveguide with cross section of 23 x 3.4 mm. The filter has a frequency tuning range of 5 percent. Figures 3; references 3: 1 Russian, 2 Western.

[261-6610]

## CHANGE OF MAGNETIZATION OF LOW-FREQUENCY FERRITES UNDER THE ACTION OF POWERFUL MICROWAVES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1237-1239 manuscript received 26 Jul 77

BLINOV, P. I. and DOLGACHEV, G. I.

[Abstract] The report describes an experiment in which a powerful microwave source changes the magnetic induction flux in a magnetized ferrite core. A ferrite doughnut was introduced into a waveguide section connected at one end to the microwave source, and at the other end to a matched terminal load. The change of magnetic induction flux in the core was registered by the emf induced in a winding on the core. Because the emf is proportional to the rate of change in the magnetic flux, it was sent to an integrating circuit made up of the mentioned winding and a resistor.



The time constant of integration was an order of magnitude larger than the duration of a microwave pulse. The same winding was used to magnetize the core. The source was a magnetron emitting in the 3-cm band with a pulse duration of 2  $\mu$ s. The change of induction flux was observed only when the position of the doughnut relative to the waveguide was such that the part of the core in the waveguide had a section on which the magnetic field of the wave was parallel to the induction vector. Rotation of the ring through 90° about the vertical axis cancelled the effect. The flux change was observed only in low-frequency ferrites. Figures 3.

[244-6610]

USSR

UDC: 621.382.33

#### THRESHOLD DEVICES BUILT ON CONTROLLABLE EQUIVALENTS OF A P-N-P-N STRUCTURE

Moscow RADIOTEKHNIKA in Russian Vol 34, No 7, Jul 79 pp 79-83 manuscript received 28 Mar 78

AREF'YEV, A. A. and STEPANOVA, L. N.

[Abstract] Five p-n-p-n threshold devices are described where the possibility of varying the voltages as well as the turn-on current and the turn-off current has been realized by varying the depth of positive and negative feedback in the equivalent of a p-n-p-n structure. The complexity of these devices increases successively, mainly with respect to the feedback system, so as to ensure better performance characteristics in terms of thermal stability, controllability and hysteresis. With the negative dynamic output resistance reduced to almost zero, the hysteresis has been minimized to a negligible level. The operating supply voltage is only 5 V, which allows for direct matching with logic microcircuits. The circuit diagram of these devices are shown and their basic technical data are given, also the essential circuit relations and performance equations. Their design is simple and, furthermore, their manufacture by integration technology is feasible. Figures 7; tables 1; references: 8 Russian.

[270-2415]

## A HOLLOW METAL-DIELECTRIC LIGHT GUIDE FOR THE INFRARED BAND

Moscow RADOPTTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1084-1088 manuscript received 5 Jun 78

KAZANTSEV, YU. N. and KRAFTMAKHER, G. A.

[Abstract] An experimental study is done on a hollow metal-dielectric infrared light guide that has low losses for linearly polarized waves. The device is a metal tube of large diameter compared with the wavelength with a dielectric layer of thickness  $d = \lambda (2N+1)/8 \sqrt{n_d^2 - 1}$  on the inside wall, where  $N$  is an integer, and  $n_d$  is the index of refraction of the dielectric. Losses are measured as well as the distribution of field intensities with respect to the cross section of the light guide and with respect to glancing angles. Losses are several times lower than those in the same guide without the dielectric layer. This gain can be increased by using dielectrics with lower losses and by improving the reflecting properties of the light guide walls. Figures 3; references 6: 3 Russian, 3 Western.

[244-6610]

USSR

UDC: 536.3:681.2.083.8

## A LINEAR TEMPERATURE TRANSDUCER

Moscow IZMERITEL'NAYA TEKHNIKA in Russian, No 3, Mar 79 pp 23-24

DERIV, V. A.

[Abstract] Thermometers and temperature regulators using semiconductor diodes are characterized by a low inertia and a linear temperature dependence of the forward junction voltage over the  $-40$  to  $+100^{\circ}\text{C}$  range. The electric circuit of such an instrument with an ideal diode and the accuracy of its operation with either a separate voltage supply or a resistor as current source are analyzed, and guidelines for a practical design are established on this basis. A transistor operating as a diode, with its base and collector joined together, should be used at high temperatures. Further improvements in the performance are expected by combining a diode transducer with an operational amplifier, but here the inherent errors of the latter must be minimized. A thermometer suitable for a relay-type temperature regulator over the  $0$ - $50^{\circ}\text{C}$  range has been built with a germanium diode and a thermally stabilized voltage supply according to these principles and including a microcircuit operational amplifier with a gain of 30. The instrument includes, furthermore, a calibration and adjustment circuit with a microammeter and appropriate resistors. It can operate with either a heater or a cooler. Figures 2; references: 3 Russian.

[748-2415]

USSR

UDC: 621.3.087.92

## DYNAMIC CHARACTERISTICS OF ANALOG-TO-DIGITAL CONVERTERS AND METHODS OF THEIR DETERMINATION

Moscow IZMERITEL'NAYA TEKHNIKA in Russian, No 4, Apr 79 pp 22-25

OSTROVERKHOV, V. V., PAVLOV, V. V. and FREMKE, A. A.

[Abstract] Errors in the encoding of random or deterministic fast-varying signals depend on the dynamic characteristics of analog-to-digital converters used for this purpose. Some of these characteristics are determined by the converter components and by the encoding method, others are determined by the converter parameters and the signal parameters. Here this is illustrated on code-to-voltage conversion and code-to-current conversion, with the analog-to-digital converter operating in a control system which also includes a comparator. The converter can be of the tracking type, or the

balancing type, have a series or parallel automatic correction, or have an analog memory at the input. The analysis is based on representation of the converter as a series combination of a linear inertial (RC) element and a nonlinear inertialess element. Both the total and the mean dynamic error as well as its random component are calculated for this equivalent circuit. The transient performance of an analog-to-digital converter and the frequency dependence of its dynamic error are determined from measurement of the time constants characterizing the circuit components and of the time parameters characterizing the input signal pulses. No simple method of measuring the converter "aperture" time has yet been developed, however, and only the spread of its readings due to system design characteristics can be easily measured. Figures 2; tables 1; references: 3 Russian.

[259-2415]

USSR

UDC: 621.3.976.7

#### A CODE-TO-PHASE CONVERTER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 pp 95-96  
manuscript received 21 Feb 78

MATCHAK, A. T. and TOMSON, T. I., Scientific-Research, Design and Planning Institute of Systems for Planning and Management in the Electrical Industry, Tallin Electrical Engineering Plant imeni M. I. Kalinin

[Abstract] A code-to-phase converter is described that is based on the principle of summation of unit time increments. The converter consists of a clock pulse generator, a pulse counter and synchronizer, and a pulse comparator. The number of logic elements is reduced by using a counter with code-controlled scaling factor. A block diagram is given and the operation of the converter is explained. The device can also be used for conversion from code-to-time intervals. Figures 2; references: 3 Russian.

[261-6610]

## AN AMPLITUDE-TO-DIGITAL SUCCESSIVE-APPROXIMATION CONVERTER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 pp 111-113  
manuscript received 2 Jan 78

CONCHAR, A. I.

[Abstract] The method of amplitude-to-time transformation gives an analog-to-digital converter with acceptable differential nonlinearity, but excessive conversion time, whereas the method of binary balancing makes the amplitude-to-digital conversion short, but increases differential nonlinearity beyond the admissible limit. In this paper the author describes a technique that realizes the advantages of both methods. A 1024-channel amplitude-to-digital converter is designed by using a five-step approximation to the digital equivalent of input signal amplitude, the state of the two most significant remaining flip-flops of the address register being determined on each step. At a clock frequency of 1 MHz, the conversion time is 26  $\mu$ s or less. The differential nonlinearity of the converter is within 5 percent over 96 percent of the working range, and this figure can be improved to 1 percent by the use of statistical leveling. Figures 3; references 4: 3 Russian, 1 Western.

[261-6610]

## A RADIOPULSE FREQUENCY MULTIPLIER

Moscow RADIOTEKHNIKA in Russian Vol 34, No 7, Jul 79 pp 86-87

VENGER, A. Z., TERESHCHENKO, N. D., KORZENKO, V. I. and YAKIMENKO, A. M.

[Abstract] A radiopulse frequency multiplier is described which includes a blocking self-oscillator with a common-base transistor circuit cut off by control pulses much shorter than the radiopulses. The amplitude of control pulses is high and their leading edge is steep so as to raise the upper cutoff frequency and to facilitate filtration of the appropriate harmonic. The device features a high transmission coefficient and makes multiplication by high factors feasible: 36 MHz can be multiplied by as much as 42. The experimental model delivers 100 mW of power at 1512 MHz, with a 22 dB suppression of parasitic components. Figures 2; references: 1 Russian.

[270-2415]

## AN ANALOG-TO-DIGITAL CONVERSION UNIT WITH A STABILIZING SYSTEM AND DIGITAL DISPLAY

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 pp 106-110 manuscript received 25 Jan 78

BORZHKOVSKIY, V. F., VLASOV, V. G., ZALYUBOVSKIY, I. I., MUKHACHEV, N. K., STERVOYEDOV, N. G. and FROLOV, A. I., Khar'kov State University

[Abstract] An analog-to-digital converter is described for measuring pulse voltages with amplitude of 0.05-11V and rise time from 50 ns to 1  $\mu$ s. Block diagrams are given of the converter and the stabilizing system. The unit has 1100 conversion levels. The converter can handle input signals of either polarity at durations of 100 ns or longer with pulse recurrence rates up to 500 Hz. Maximum conversion time is 550  $\mu$ s without stabilization, and increases to 1 ms with stabilization. Integral nonlinearity is 0.2 percent and temperature instability (5-50°C) is  $4 \cdot 10^{-2}$  percent/°C without stabilization, and  $2 \cdot 10^{-3}$  percent/°C or less with stabilization. Limits of stabilization are  $\pm 2.5$  percent. Provision is made for code output to computers in TTL levels. Figures 3; references: 5 Russian.

[261-6610]

## A SIMPLE CONVERTER FOR CHANGING DIGITAL CODE INTO DIRECT CURRENT

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 p 94 manuscript received 17 Feb 78

KOLTUNOV, B. G., KRAVCHENKO, V. V. and MAYSTRENKO, A. K.

[Abstract] The paper describes an opamp code-to-current converter. The conversion process is based on summation of ten digit-driver currents in a load resistor through a series voltage stabilizer. The regulating element is a compound transistor, and the opamp serves as the comparing and amplifying component. A variable resistor sets the reference voltage. A schematic diagram is given with equations for determination of electrical parameters. The bit capacity is 10 places, output current is 0-5 mA, and conversion error does not exceed 0.3 percent in a temperature range of 5-40°C and load impedance variation from 0 to 2.5 k $\Omega$ . Figures 1; references: 4 Russian.

[261-6610]



USSR

UDC: 621.313.291:537.311.62.001.24

## AN EXPERIMENTAL HOMOPOLAR MACHINE WITH SUPERCONDUCTING INDUCTORS

Moscow IZVESTIYA AKADEMII NAUK SSSR, ENERGETIKA I TRANSPORT in Russian, No 2, Mar-Apr 79 pp 61-69 manuscript received 15 Mar 78

ALIYEVSKIY, B. L., OKTYABR'SKIY, A. M. and ORLOV, V. L., Moscow

[Abstract] An experimental machine is being built and tested which combines the concepts of cylindrical or disk armatures with superconducting inductors and those of a homopolar generator or motor. The design is based on approximate geometric and thermal similarity, with the specific axial force as the idemparemeter, for scaling up from a small 5 kW machine with solid or segmental copper brushes and slip rings rated for 160-1000 A to a large 300 kW machine with liquid-metal slip rings rated for 30,000 A. Its nominal voltage is 10 V and its nominal speed is 6000 rpm, the 70 kg armature with strands of niobiumtitanium superconductor wire twisted around a copper core all placed in a cryostat for cooling with liquid helium under a pressure of  $10^{-4}$ - $2 \cdot 10^{-4}$  mm Hg. The machine was tested with a nominal field current of 300 A producing an axial force of 1000 N and with a mean magnetic induction in the armature of 2.35 T producing a useful magnetic flux of 0.12 Wb. The magnetic field was plotted with Hall probes, with the armature coil in the superconducting state and in the normal state respectively. The speed-voltage characteristics were measured at various constant field currents and the speed-(field)current characteristics were measured at various constant voltages, the results essentially confirming the theoretical predictions. The machine was furthermore tested without and with ferromagnetic shields around the inductor coil. Figures 6; tables 1; references: 17 Russian.

[260-2415]

USSR

UDC: 621.315.2

## SELECTION OF A SUITABLE CONDUCTING MATERIAL FOR ELECTRIC POWER TRANSMISSION OVER SUPERCONDUCTOR LINES

Minsk IZV. VUZ: ENERGETIKA in Russian, No 6, Jun 79 pp 88-91 manuscript received 24 Jan 79

FEDIN, V. T., candidate in technical sciences, Dotsat, "Order of Labor's Red Banner" Belorussian Polytechnic Institute; BELYANCHEV, YU. V., Candidate in technical sciences, "Order of Lenin" Kharkov Polytechnic Institute imeni V. I. Lenin

[Abstract] The technoeconomic indicators of various superconductor materials

for electric power transmission lines are analyzed comparatively, for selection purposes, on the basis of the same operating conditions. The algorithm of calculations accounts for the fact that the diameter of a tubular conductor is uniquely determined by the power to be transmitted in the case of soft superconductor materials and that no such relation exists in the case of hard superconductor materials. In the latter case the optimum diameter is selected from among a series of discretely different diameters for each of which one calculates in sequence: the outside diameter of the outer coaxial conductor, the magnetic field intensity at the surfaces of both inner and outer conductors, then the critical current density in both conductors, their cross sections and thicknesses, and finally the power loss in the superconductor. This power loss as a function of the diameter is then optimized. The algorithm has been programmed on a Minsk-22M digital computer. Numerical results are shown for 110 and 220 kV lines using niobium alloys (Nb-Zr, Nb-Ti), or niobium compounds (Nb<sub>3</sub>Sn, Nb<sub>3</sub>Ge), or lead. Lead is found to be least economical, niobium stannide to be most suitable for 2-3 GW power levels, and niobium alloys to be economically not competitive. Using the recently discovered niobium germanide may further reduce the cost of superconductor transmission lines by 20-30 percent at the economical power levels. Figures 2; tables 1; references 7: 4 Russian, 1 German, 2 Western.

[281-2415]

USSR

UDC: 621.317.44:537.312.8

#### SUPERCONDUCTIVE QUANTUM MAGNETOMETER WITH INDEPENDENT PUMPING

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1979, pp 1087-1089 manuscript received 10 Aug 77

LIKHAREV, K. K.: SNIGIREV, O. V. and TINCHEV, S.S.

[Abstract] Single-contact superconducting quantum magnetometers (SKVID) usually have a circuit as follows: pumping current is introduced directly into the oscillation loop, inductively connected to the quantum interferometer--a superconducting ring closed by a Josephson contact. Flux of the measured magnetic field across the interferometer ring changes the ring's impedance at a pumping frequency of  $\omega$  and thereby the amplitude of induced loop oscillations. The sensitivity of the magnetometer is usually limited by the noise of input stages of the amplifier. To compute the transconductance of the signal characteristic curve it is necessary to find the link between the complex amplitude of oscillations in the loop, amplitude pumping and the measured flux. The cause for the increase in transconductance of the signal characteristic can be seen from a vector diagram: fluxes induced in the ring by pumping and oscillations in the loop are virtually

equal in magnitude and are almost in opposite phases. Change in signal flux is always offset by equal change in amplitude of total flux. Preliminary experiments done on the proposed SKVID circuit with a NbNb point contact at a frequency of 28 MHz showed that the relationship of  $\Phi$  oscil versus  $\Phi$  pump is actually the same as was calculated. Figures 2; references: 4 Western.

[230-8617]

USSR

UDC: 621.372.8.001.24:537.312.62

INTERACTION OF ELECTROMAGNETIC WAVES WITH SUPERCONDUCTORS AND ANALYSIS OF THE CHARACTERISTICS OF SUPERCONDUCTIVE WAVEGUIDES IN THE MICROWAVE BAND

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1078-1083 manuscript received 10 Feb 75; after revision, 15 Feb 78

ANDRUSENKO, A. M., BOGOMOLOV, A. S., KRAVCHENKO, V. F. and MENDE, F. F.

[Abstract] The authors find parameters and characteristics of real waveguides that have walls that are either made of a normal conductor with a sputtered superconductive layer, or are made of a superconductor of finite thickness where inleakage of the field must be considered. Equivalent boundary conditions are found on the surface of the superconductor for the tangential components of the electromagnetic field, and the electrodynamic characteristics are found for thin-layer superconductive waveguides and also for waveguides with walls of sandwich type. The results can be used for optimum selection of waveguide wall thicknesses, and also the thicknesses of superconductive coatings that give predetermined characteristics of waveguiding systems used in microwave engineering. Figures 4; references 7: 6 Russian, 1 Western.

[244-6610]

## SUPERCONDUCTIVE THIN-FILM PARAMETRIC AMPLIFIER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1977 pp 1097-1099 manuscript received 27 Oct 77

GERSHENZON, M. YE. and GUBANKOV, V. N.

[Abstract] Much attention has recently been given to the use of the non-linear properties of semiconductors, especially the non-linearity of Ginzburg-Landau (GL) unpairing. The idea of creating a parametric amplifier (PU) using the effect of unpairing nonlinearity was advanced: the upper boundary frequency of such a PU was evaluated and the coefficients of modulation of kinetic inductance for various pumping conditions were calculated. Attainment of unpairing currents is possible in thin and narrow superconducting films. The superconducting film, as a working component of the parametric amplifier, can be described by introducing its dynamic Q-factor, as is done for varactors. In selecting an optimum working temperature for superconducting-film parametric amplifiers, it should be taken in to account that when T is reduced the active conductivity of the film falls sharply; this leads to an increase in dynamic Q and a reduction in amplifier noise. The superconducting-film PU has several advantages over current amplifiers of other types in the range of 0.5-1 GHz: simplicity of design and low pumping power. The noise temperature of such a PU should be on the order of several degrees. Superconducting-film PU should be of considerable value as low-noise IF amplifiers, especially as the second stage in receivers operating in the millimeter or submillimeter ranges of wavelengths at the temperature of liquid helium. The authors thank L. S. Kuz'min, K. K. Likharen and V. S. Etkin for helpful discussion of the work. Figures 1; references 10: 6 Russian, 4 Western.

[230-8617]

USSR

UDC: 62-83:621.313.333.2.07

PROBLEMS OF OPTIMUM FREQUENCY CONTROL OF A TWO-MOTOR INDUCTION DRIVE WITH ELASTIC CONSTRAINTS

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 79  
pp 615-620 manuscript received 22 Nov 77, after revision 24 Mar 78

CAVRILOV, PETR DANILOVICH, candidate in technical sciences, docent, and  
YESHCHIN, YEVGENIY KONSTANTINOVICH, candidate in technical sciences, docent.  
Kuzbass Polytechnical Institute

[Abstract] The authors consider the problem of two squirrel-cage induction motors operating on a single shaft. The motors are of the same type, but corresponding parameters may differ. The rigidity of the transmission reduced to the motor shafts may differ. Power supply is from static frequency converters with independent output frequencies and voltages. Expressions are found that relate the controlling parameters of the motors to the parameters that characterize the state of the system. These relations optimize some criterion functional for control or the transient process. It is assumed that control is by a frequency method with phase coordinates. The results are applied to a specific example of optimum frequency control of a two-motor induction drive that contains elastic links. Figures 1; references: 2 Russian.

[276-6610]

USSR

UDC: 621.3.017

CALCULATING THE PARAMETERS OF AN ELECTROMAGNETIC FIELD IN SHIELDS OF COMPLETELY ASSEMBLED CURRENT CONDUCTORS

Minsk IZV. VUZ: ENERGETIKA in Russian, No 6, Jun 79 pp 8-14 manuscript received 5 Apr 78

GERASIMOVICH, A. N., candidate in technical sciences, Dotsent and BULAT, V. A., engineer

[Abstract] The steady-state equations of an electromagnetic field in complex amplitudes are used as the basis for calculating the parameters of such a field in solid nonmagnetic shields in an assembly of current conductors, specifically in the case of parallel cylindrical conductors. The solution of these equations in the complex plane, assuming a magnetic field intensity with both an active component and a reactive one at both surfaces, yields the components of the electric field intensity as well, also the shield currents, the eddy currents, and the power loss. Calculated are, furthermore, the dependence of current magnitude and phase as well as of power loss on the distance between shields and on the impedance of the

saturable choke inserted between them. The results are applicable to the design of induction heaters and of metallic shields for cryogenic cables. The paper was presented by the Department (Kafedra) of Electrical Stations, Belorussian Order of Labor's Red Banner Polytechnical Institute. Figures 3; references: 4 Russian.

[281-2415]

USSR

UDC: 621.3.047:621.313.2

ANALYSIS OF SOME CAUSES OF INSTABILITY OF TRANSIENT RESISTANCE OF BRUSH-COMMUTATOR UNITS OF ELECTRIC MICROMOTORS

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 6, Jun 79 pp 553-555 manuscript received 15 Feb 77

KHARIZMAN, YUZEY DAVYDOVICH, engineer, SKOROSPESHKIN, ALEKSEY IVANOVICH, doctor in technical sciences, professor, Kuybyshev Polytechnical Institute, PUTRYA, VLADIMIR FEDOROVICH, candidate in technical sciences, and KHARATI, RAMAZ GRIGOR'YEVICH, engineer, laboratory chief, VNIITME [All-Union Scientific-Research Institute of the Technology of small electrical machines], Tbilisi

[Abstract] Experience with a wide range of commutator micromotors has shown that the stability of transient resistance is determined both by the motor design and by the state of the components of the brush-commutator unit. The following classification is proposed for the most common sources of instability of transient resistance: motor design; foreign bodies in brush material; commutator surface flaws. Motor design faults include inadequate protection from dust and bearing lubricant in the brush area. Foreign inclusions of sulfur and the oxides of iron, aluminum and silicon may reach dimensions commensurate with the brush contact area. This not only destabilizes transient resistance, but also increases wear and corrosion. Surface flaws include both abrasive grains from machining operations, and traces of lubricant, dust and perspiration remaining on the surface after assembly. When surfaces are plated, the plating stresses may cause cracking, and depleted electrolytes may introduce products of electrolysis into the plated surface. Figures 6.

[252-6610]



## A NEW TECHNICAL LEVEL FOR TOOL PRODUCTION

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 79 pp 35-39 manuscript received 9 Jan 79

PONOMAREV, V. A., director of the Kiev Plant of Relays and Automatic Equipment ineni the Fiftieth Anniversary of the USSR

[Abstract] The author discusses improvements that have been made in metal-forming tools. Hard-alloy punch and die sets are now made with the most advanced methods including electrosark erosion machining and machine tools with preset numerical control. The Kiev Plant of Relays and Automatic Equipment has a special section for accelerated planning and manufacture of new metal-forming tools. Figures 3.

[250-6610]

## ON WORK OF THE CENTRAL ELECTRICAL ENGINEERING LABORATORY AT PEO (PLANNING AND ECONOMICS DIVISION) "KHAR'KOVENERGO"

Kiev ENERGETIKA I ELEKTRIFIKATSIYA in Russian No 2(100), Apr/Jun 79 pp 30-31

KRIVONOS, A. F. and MAMIN, A. S., engineers, Central Electrical Research Laboratory, PEO (Planning and Economics Division) "Khar'kovenergo"

[Abstract] A Central Electrical Engineering Laboratory directed by Glavsel'energo, the Ministry of Power of the Ukrainian SSR, was set up in 1977 at the PEO (Planning and Economics Division) "Khar'kovenergo." This laboratory develops and introduces new equipment for rural and municipal power distribution systems, and also provides organizational and technical guidance to the enterprises of power systems on introducing and using new equipment. In 1978 the laboratory developed automation and remote control facilities and devices for improving productivity and work safety in operation of distribution networks. The laboratory has developed and produced a mobile unit for burning out defective insulation on high-voltage cables, and also an automated system for de-icing 6-10 kV radial lines. Now under development is a mobile thyristorized shorting cell for de-icing 6-10 kV overhead lines. A major area of work at the laboratory is large-scale automation of three regional power networks in the Khar'kovenergo system, which will be a pilot facility for future total automation of rural power distribution systems.

[240-6610]

## CALCULATION OF ELECTROMAGNETIC PROCESSES IN A SINGLE-PHASE HOMOPOLAR INDUCTOR-TYPE GENERATOR WITH CONSIDERATION OF SATURATION OF THE SERRATED REGION

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 79  
pp 635-637 manuscript received 23 May 79, after revision 19 Jun 79

PIAKH, GENNADIY KONSTANTINOVICH, graduate student, and YEVSIN, NIKOLAY FEDOROVICH, candidate in technical sciences, senior instructor, Novocherkassk Polytechnical Institute

[Abstract] A method is proposed for calculating the instantaneous values of currents and voltages of a single-phase homopolar generator with consideration of saturation of the serrated region. The method is based on successive solution of a system of differential equations for the electric circuits of the generator and a system of nonlinear algebraic equations that show the relation between the flux linkages and currents of the armature and field windings. Saturation is accounted for by a family of transient responses of magnetization of the serrated zone. It is shown that such saturation has a considerable influence on voltage quality. Figures 1; references: 2 Russian.

[276-6610]

## ELECTRIC STRENGTH OF MICROMOTORS OPERATING IN A LOW-PRESSURE GAS

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 79  
pp 655-659 manuscript received 8 Feb 77; after completion, 13 Jun 77

GORBUNOV, YURIY KONSTANTINOVICH, candidate in technical sciences, docent, GUKOV, VLADIMIR, IOSIFOVICH, candidate in technical sciences, LEVIN, BORIS, MIKHAYLOVICH, engineer, and ROZHKOV, VIKTOR MIKHAYLOVICH, candidate in technical sciences, docent Novosibirsk Electrical Engineering Institute

[Abstract] The electric strength of micromotors decreases with operation in low-pressure gas due to the reduced breakdown voltage of the gas. In this paper an investigation is made of individual electrical phenomena based on simplified models that characterize micromotor operation in air and other gases, the particulars of their manufacture, and various kinds of destruction of insulation. The breakdown voltage of insulation cannot be calculated from Paschen curves based on similarity for a homogeneous electric field because of the geometric shape of the motor and the enclosure, and the probability of insulation breakdown from different directions.

A generalized curve has to be plotted for the breakdown voltage of the whole system as a function of pressure with consideration of all determining factors. The current-voltage curves for the breakdown current of micro-motor insulation models do not conform to scaling laws in a gas discharge, and differ considerably from data in the literature. Therefore if the insulation quality is to be judged from the form of the breakdown current, special curves must be plotted for each specific case. Figures 3; references: 8 Russian.

[276-6610]

USSR

UDC: 621.313.333.045.001.2

#### IMPROVING THE WINDINGS OF MULTISPEED INDUCTION MOTORS

Moscow ELEKTRICHESTVO in Russian No 6, Jun 79 pp 41-48 manuscript received 14 Nov 78

DARTAU, A. A., candidate in technical sciences, All-Union Scientific-Research Institute of Electric Machine Building

[Abstract] The author reviews modulation techniques of laying out pole-change (multispeed) windings: pole-amplitude modulation and phase mixing. It is shown that such methods lead to lower and intermediate harmonics in the mmf of the windings, which has a detrimental effect on mechanical characteristics of the motor, causing synchronous torques, noise, vibration and additional losses. A general-purpose method is proposed for arranging uncoil multi-phase windings that is based on using star properties of mmf and rational selection of phase makeup independently of P.A.M. and phase mixing methods. It is shown that the proposed windings optimize the harmonic makeup of the mmf. A system of notations is proposed for the connections for the windings in the form of number series and formulas, and a method is given for harmonic analysis of the mmf based on using winding formulas. Figures 2; tables 1; references 6: 2 Russian, 4 Western.

[239-6610]

## A METHOD OF MONITORING TEST VOLTAGE IN POWER TRANSFORMER TESTS

Kiev ENERGETIKA I ELEKTRIFIKATSIYA in Russian No 2(100), Apr/Jun 79 pp 20-22

YAKIMENKO, V. I., engineer, Khar'kovenergo Industrial Power Association

[Abstract] A method is described for using an S-96 kilovoltmeter to monitor test voltage in tests of the TMN 5600/35 transformer with low-voltage winding of 10 kV. This meter has good operational characteristics and is available in all mobile electrical laboratories. In testing low-voltage windings, the instrument is connected in parallel with the test object and records the process of voltage rise from zero to 30 kV. As the measurement limit of the meter is 30 kV, simple modifications involving voltage dividers must be made on the high-voltage side, where the effective test voltage is 72 kV. The voltage divider is connected in parallel with the winding, and the kilovoltmeter is connected across a certain part of the divider that is determined by trial and error. It is suggested that the high-voltage lead of the IOM-100/25 transformer with Pr-Vr-u38 feed-through insulator be used as the voltage divider.

[240-6610]

## CALCULATION OF TRANSIENTS AND STABILITY IN CONTROLLED-RECTIFIER INVERTERS

Moscow IZVESTIYA AKADEMII NAUK SSSR, ENERGETIKA I TRANSPORT in Russian, No 2, Mar-Apr 79 pp 9-16 manuscript received 12 Feb 78; after revision, 14 Dec 78

FLINTERNIK, S. R. and LUKASHEV, V. A., Leningrad

[Abstract] Under consideration is a symmetric 3-phase or  $n$ -phase inverter with controlled rectifiers and a  $k$ -phase commutator, and not only the branches on the a.c. side but also the load on the d.c. side represented by equivalent RL-series circuits. The transients in this device are calculated on the basis of differential-difference equations of energy balance for  $k+1$  equivalent circuits in sequence. An appropriate Laplace transformation and analog simulation yields a transcendental equations for the load current and the commutation angle which, for given initial conditions, can be solved numerically. This method is applicable to inverters operating in the normal mode or, with properly modified simulation, to inverters operating in the high-power mode with the commutation interval longer than the repetition period. The stability of such inverters can be determined directly from these transcendental equations for each commutation step, after their linearization. Figures 5; references: 7 Russian.

[260-2415]

## CALCULATION OF PROCESSES OCCURRING IN THE LOAD CIRCUIT OF POLYPHASE FREQUENCY CONVERTERS

Moscow IZVESTIYA AKADEMII NAUK SSSR, ENERGETIKA I TRANSPORT in Russian, No 2, Mar-Apr 79 pp 17-26 manuscript received 2 Dec 77; after revision, 22 Nov 78

BOTCHITSEV, G. M. and IN'KOV, YU. M., Moscow

[Abstract] Electric drives in self-contained vehicles include a variable-speed motor energized and automatically controlled through a frequency converter. Here the performance of a general polyphase-polyphase frequency converter with any number  $m_1$  of input (supply phases and an odd number  $m_2$  of output (load) phases is calculated, assuming a supply power incommensurable with the load power and a commutation interval much shorter than the oscillation period. The supply voltage across each input phase is assumed to be constant and sinusoidal. The load is assumed to be symmetric phasewise, with the waveform of the output voltage independent of the load factor and with the effect of multiple-frequency ripple negligible. The polarity of the output voltage reverses jumpwise, which is permissible over a wide range of the frequency conversion ratio. Voltage drops in the power thyristors and the impedances of current-limiting chokes are included in the equivalent load. On this basis, transfer functions are derived for the frequency converter constituting an open circuit with pulse-amplitude modulation and for subsequent calculation of the transient response as well as the frequency dependence of the steady-state current. The thus obtained expressions yield also the maximum currents, important for selection of rectifiers and design of the system protection. Figures 3; references: 6 Russian.

[260-2415]

## NON-CANONICAL HARMONICS OF THYRISTORIZED CONVERTER VOLTAGE

Moscow ELEKTRICHESTVO in Russian No 6, Jun 79 pp 69-71 manuscript received 13 Jul 78

POPOV, S. G., candidate in technical sciences, Moscow

[Abstract] Rigorous analytical expressions are given for the non-canonical harmonics of rectified voltage of a converter when the supply voltages and control are asymmetric. The asymmetry of the three-phase voltages that feed the converter without a neutral wire is characterized only by the

symmetric component of the inverse sequence of voltages. This component in combination with asymmetry of control is what determines the asymmetric nature of the output emf of the converter. To study the non-canonical harmonics, the curve for the output emf of the converter is resolved into components with subsequent isolation of those that contain information on the non-canonical harmonics. Fourier transformation then yields analytical formulas for the complex amplitudes of the non-canonical harmonics. Figures 2; references: 4 Russian.

[239-6610]

USSR

UDC: 621.316.57.001.4

#### A METHOD OF AND A CIRCUIT FOR GENERATING A RECOVERY VOLTAGE IN TEST EQUIPMENT

Minsk IZV. VUZ: ENERGETIKA in Russian, No 6, Jun 79 pp 19-24 manuscript received 14 Sep 78

KORZUN, P. A., candidate in technical sciences, Dotsent and MYASTSOV, A. N., engineer

[Abstract] A method of synthetically generating a recovery voltage has been developed for use in testing of circuit breakers. It is based on the principle of piecewise duplication of the voltage recovery curve, this curve being fictitiously divided into two segments: a steep rise followed by a flatter and slightly oscillatory rise. The circuit for thus generating a recovery voltage with the circuit breaker across the high-voltage line consists of four regulating elements: a resistor in series with a capacitor and another capacitor, an inductance coil connected across the latter or disconnected from it through a switch for the respective two stages of the recovery process. The capacitors are designed for action after full-current breaking and for minimum energy storage without deviating from the normal recovery curve. Numerical calculations and graphical analysis indicate the feasibility of a 2-stage or a 3-stage circuit for synthetic voltage recovery. The paper was presented by the Department (Kafedra) of High Voltage Technology (TVN), Ural Order of Labor's Red Banner Polytechnical Institute imeni S. M. Kirov. Figures 3; references: 3 Russian.

[281-2415]



# A FAST-RESPONSE FILTER FOR SMOOTHING THE OUTPUT SIGNAL OF POWER CONVERTERS USED IN AUTOMATIC PROTECTIVE RELAYING

Minsk IZV. VUZ: ENERGETIKA in Russian, No 6, Jun 79 pp 15-19 manuscript received 30 Jan 79

BENIN, V. L., doctor in technical sciences and SAIDOV, A. S., engineer, "Order of Lenin" Kharkov Polytechnic Institute imeni V. I. Lenin

[Abstract] One of the authors has developed a filter on the principle of compensating the a.c. components with the aid of a CR signal distributing circuit, an RC phaseshift compensating circuit, and an integrating operational amplifier. Here the feasibility of using such a filter for smoothing the output signal of fast-response power amplifiers in automatic protective relaying systems is examined. An analysis based on an equivalent fourpole network and calculating its transfer function indicates a satisfactory suppression, to below 5 percent of the damped fundamental-frequency signal component. Figures 1; references: 5 Russian.

[281-2415]

# DESIGN OF A MAGNETIC INDUCTION TRANSDUCER TO CHECK HIGH-COERCIVITY MAGNETIC MATERIALS

Moscow RADIOTEKHNIKA in Russian No 6, Jun 79 pp 31-32 manuscript received 11 Sep 78

GRIDNEV, A. I., candidate in technical sciences, CHOKHELI, M. A., and DVORNIKOVA, L. K., engineers

[Abstract] It is shown that if a very narrow slot is cut inside a permanent magnet perpendicular to the lines of force, the induction of the magnet material can be found by measuring the induction in the slot. The field is calculated inside of a magnet made of an intermetallic samarium-cobalt compound, and the degree of inhomogeneity is determined. It is found that the inhomogeneity of magnetic induction lengthwise of such a magnet is 2-3 percent. It is experimentally shown that a magnetically hard insert can be used in a slot 0.3 mm deep for quality control of the magnetic properties of high-coercivity magnetic materials and magnets of simple shape. Figures 2; references: 4 Russian.

[250-6610]

USSR

UDC: 681.142.32:621.34:621.313.333

# DIGITAL COMPUTER SIMULATION OF A FREQUENCY-CONTROLLED ELECTRIC DRIVE WITH A LINEAR INDUCTION MOTOR

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 6, Jun 79  
pp 517-523 manuscript received 31 May 76, after revision 5 Jul 78

VOLDYREV, GENNADIY LEONIDOVICH, candidate in technical sciences, docent,  
and KLEPKA, PETR KONSTANTINOVICH, Senior scientific research worker,  
Leningrad Institute of Railroad Transportation Engineers

[Abstract] An electric induction drive for high-speed surface transport requires speed control over a wide range. Therefore the linear induction motor is fed by a self-contained voltage inverter. The mutual influence of power supply, inverter and motor makes it necessary to treat them as a unified system. Since longitudinal edge effects play a considerable part in powerful high-speed linear induction motors, the equations derived for normal induction motors are not strictly applicable to analysis of such traction drives. Therefore the authors develop a mathematical model that can be used in studying static and dynamic working conditions of high-speed linear induction motors in the case of frequency control with consideration of all principal design peculiarities of the motor. The spatial distribution of the primary magnetic field is studied as a basis for describing the actual geometry of the magnetic circuit. The magnetic field is calculated by an integral equation technique with an algorithm written in ALGOL for a BESM-4M digital computer. The calculated and experimental values of the magnetic field induction in the gap of the motor differ by 6-8 percent, the discrepancy for currents is 10 percent, and electromagnetic forces differ by 10-21 percent. Figures 3; references 9: 6 Russian, 3 Western.

[252-6610]

USSR

UDC: 681.326.7:621.316.925

# CONTINUOUS LOGIC INSPECTION OF PROTECTIVE RELAY DEVICES

Moscow IZVESTIYA AKADEMII NAUK SSSR, ENERGETIKA I TRANSPORT in Russian,  
No 2, Mar-Apr 79 pp 38-48 manuscript received 27 Jul 77

POLYAKOV, V. YE., ORLOV, V. A. and FEDOTOV, V. P., Sverdlovsk

[Abstract] Continuous inspection of protective relay systems is an effective method of increasing their functional reliability. Such an inspection

involves an analysis of the state of individual system components. "Passive" inspection produces fault signals only, with possible indication of the fault location. "Active" inspection produces target interaction of the inspecting device with the inspected device during their simultaneous operation. The target action can be placing out the relay system or its component for the purpose of preventing a nonselective (false-alarm) shutdown or placing in the standby during a fault, or both. Algorithms of each mode of inspection are constructed on the basis of Boolean algebra and logic tables, also appropriate interconnection and functional schematic diagrams are drawn for the simple PZ-2 distance relaying system. Figures 6; tables 4; references: 6 Russian.

[260-2415]

USSR

AN ACOUSTOELECTRONIC TARGET: PART 2

Moscow RADIO in Russian No 6, 1979 pp 22-25

ZAKHAROV, V., Klimovsk, Moskovskaya Oblast

[Abstract] This is the concluding article on a construction project, giving details of layout and assembly. A schematic diagram of the power supply is given together with working diagrams of the chassis with dimensions and spacing of bolt holes, mounting bases and so forth. The alignment procedure is described. Figures 3.

[253-6610]

USSR

UDC: 535.36

A CONDUCTIVE ELLIPSOID IN A LOW-FREQUENCY ELECTROMAGNETIC FIELD

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 22, No 6, 1979 pp 740-749 manuscript received 16 May 78

LEVIN, M. L. and MURATOV, R. Z.

[Abstract] Stevenson's approximate method ("Journal of Applied Physics," Vol 24, 1953, pp 1134 and 1143) is applied to the problem of low-frequency diffraction of electromagnetic waves by a conductive ellipsoid. First and second approximations are found in analytical form for the electric and magnetic moments induced in the ellipsoid. These expressions show that the parameter in the field expansion with respect to powers of the wave number is the ratio of frequency to conductivity for the electric moment, and the square of the ratio of a characteristic dimension to the thickness of the skin layer for the magnetic moment. The ponderomotive force acting on the ellipsoid in the field of a plane wave is considered as an example. References 14: 8 Russian, 6 Western.

[251-6610]

USSR

UDC: 535.43+534.321.9

NON-MUTUAL EFFECT IN PASSAGE OF LIGHT THROUGH AN ULTRASONIC BEAM

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1979 pp 901-905 manuscript received 9 May 78

ZIL'BERMAN, G. YE. and KUPCHENKO, L. F.

[Abstract] When light hits a dielectric specimen, in which an ultrasonic wave is being propagated, several effects occur which have a different order of amplitude of oscillations of the index of refraction--a first order effect. A second order effect is the difference between the velocities of waves moving in opposite directions, called an independent effect. This effect naturally vanished when  $\theta = 0$ . It is very small where  $\theta$  is similar to unity, especially  $\theta = \pm \pi/2$  and reaches its highest value at angles of  $\theta$  near Braggian values. With design of devices based on the non-reciprocal effect, it is advantageous to reconcile oneself to a somewhat lower value of  $\Delta n$ , since at  $\beta = \pi$  the intensity of the light wave for which the non-reciprocal effect occurs almost changes into zero. Figures 5; references: 2 Russian.

[230-8617]

# HORIZONS OF STRAIGHT VISIBILITY AND APPLICABILITY LIMITS FOR THE METHOD OF NORMAL WAVES UNDER CONDITIONS OF SUPERREFRACTION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79  
pp 1323-1331 manuscript received 17 Jul 78

BULDYREV, V. S., GRIKUROV, V. E. and SALIKOV, S. P.

[Abstract] The problem of horizons, i. e., boundaries between a conventional shadow zone and a bright zone is analyzed in the case of superrefraction, when the modified refractive index is minimum. Generally the method of rays is most applicable near to the source at higher frequencies and the method of rays is most applicable near to the source at higher frequencies and the method of normal waves is most applicable far from the source at lower frequencies. Here the coincidence region of distances and frequencies is determined where both methods yield the same results. A horizon, particularly that of a straight (once reflected) wave, is now defined as a line in space which separates two regions of a normal-wave series: one where the low-order terms increase with higher order number and one where they monotonically decrease from the first-order term on. The modified refractive index is  $M(r) = 1/2 [\epsilon(r) - 1 + 2 \frac{(r-a)}{a}]$  ( $r$  denoting the distance from the source,  $a$  denoting the Earth radius, and  $\epsilon$  denoting the dielectric constant of air). The wave field, which vanishes at the Earth surface, is described by a contour integral with the source located inside a waveguide and the observation point located above it. A numerical evaluation of this integral, and the integrand functions, indicates that subhorizons almost exactly represent the lower boundary of the coincidence region and Fok horizons lie approximately in the middle of this region. Figures 2; references 4: 3 Russian, 1 German.

[273-2415]

# A METHOD OF NUMERICAL SOLUTION OF PROBLEMS OF DIFFRACTION OF H-POLARIZED ELECTROMAGNETIC WAVES BY OPEN CYLINDRICAL SURFACES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1011-1016 manuscript received 5 Jan 78

ZAKHAROV, YE. V. and PIMENOV, YU. V.

[Abstract] In a previous paper ["Radiotekhnika i elektronika," Vol 22, No 4, 1977, p 678] these authors considered the plane problem of diffraction



on an H-polarized electromagnetic field by an open cylindrical surface  $S$  with cross sectional contour  $\Gamma$  in the  $xOy$  plane on which an orthogonal system of curvilinear coordinates  $q, \tau$  was introduced in such a way that the variable  $q$  had a fixed value  $q = q_0$  on contour  $\Gamma$ , while  $\tau$  varied over a range  $\alpha \leq \tau \leq \beta$ . The diffraction problem was reduced to a differential equation on contour  $\Gamma$  relative to the scalar potential  $\Phi(\tau)$ . In this paper the authors propose a method of solving the problem that is based on reduction to a system of two integral equations relative to the current density  $j$  and scalar potential  $\Phi$ . This is a fairly universal technique that is practically independent of the shape of contour  $\Gamma$ . Some numerical results are given for calculations of the radiation patterns for the secondary field in the case of a circular cylindrical surface. Figures 3; references: 5 Russian.

[244-6610]

USSR

UDC: 538.311

ON A METHOD OF RECONSTRUCTING THE CURRENT DISTRIBUTION IN A RADIATOR FROM EXPERIMENTAL VALUES OF THE ELECTROMAGNETIC FIELD IN THE WAVE ZONE

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 22, No 6, 1979 pp 772-775  
manuscript received 20 Jul 78

KOROTKOV, V. S. and TURCHIN, V. I., Scientific-Research Institute of Radio Physics

[Abstract] Practical problems sometimes require data on the distribution of radiation sources with a characteristic period of oscillations of the order of a wavelength or more that determine the structure of the field in the wave zone. When approximate experimental solution of the problem is permissible, one can either determine the improper elements of the phased antenna array account for the perturbations introduced by isolated components of the antenna structure in the amplitude-phase distribution, or evaluate deformation of the antenna reflector and so on. In this paper a method is proposed for constructing an approximate (smoothed) solution of this inverse problem and evaluating its accuracy, and results are given from an experimental determination of the amplitude and phases of currents in the elements of a linear display from measurement data in the near zone using the proposed technique. The authors thank M. A. Miller and N. M. Tseytlin for discussing the results and for constructive criticism, A. L. Fogle', V. A. Antonov and I. M. Fortus for assisting with the experiment, N. V. Veksler and L. R. Semenova for helping with computer processing of the data. Figures 5; references: 7 Russian.

[251-6610]

## ON THE INFLUENCE THAT RECOMBINATION PROCESSES AND NONISOTHERMICITY OF AN IONOSPHERIC PLASMA HAVE ON PARAMETRIC THERMAL INSTABILITY

Gor'kiy ISV. VUZ: RADIOFIZIKA in Russian Vol 22, No 6, 1979 pp 711-715  
manuscript received 22 May 78

GRACH, S. M., POLYAKOV, S. V. and RAPOPORT, V. O., Scientific-Research  
Institute of Radio Physics

[Abstract] An examination is made of the influence that recombination processes have on parametric thermal instability, and it is shown that the instability threshold in the strongly ionized F-layer of the ionosphere decreases with an increase in the ratio of ion temperature to electron temperature, i. e. with increasing nonisothermicity. The authors thank N. A. Mityakov and V. Yu. Trakhtengerts for discussion. Figures 2; references: 10 Russian.

[251-6610]

## BEAM TRAJECTORIES IN AN IONOSPHERIC WAVEGUIDE WITH CONSIDERATION OF WEAK PERTURBATION OF PERMITTIVITY

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 22, No 6, 1979 pp 696-702 manuscript received 6 Feb 78; after revision, 2 Nov 78

MIROLYUBOV, V. N., Irkutsk State University

[Abstract] The author considers the problem of determining beam trajectories with propagation of radio waves in ionospheric waveguide channels. An analysis is made of the case where weak perturbation of permittivity takes place against a background of a parabolic profile, i.e. where the permittivity is represented as  $\epsilon = \epsilon_0 + \nu \epsilon_1$ , where  $0 < \nu \ll 1$ . A method of averaging is used to study the influence that inhomogeneities have on beam trajectories in irregular and regular ionospheric waveguides. The beam trajectory is found in the first approximation, and corrections are made to the angles of arrival of the unperturbed beam at a fixed point. The method is applicable at great distances from the source as well as in the short-range case. The author thanks M. V. Tinin for formulating the problem and discussing the work, and also K. V. Svistunov for doing the numerical calculations. Figures 1; references: 11 Russian.

[251-6610]

## SCATTERING OF A PLANE WAVE BY A METAL CONE NEAR ITS AXIS OF SYMMETRY

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1979 pp 886-896 manuscript received 6 Mar 78

LANDSBERG, I. L.

[Abstract] The problem of scattering of electromagnetic waves by a finite circular cone with a flat base has long been discussed in the literature. The first solution to such a problem for a disk, allowing for primary edge waves (according to Sommerfeld) was derived in 1950 by Braumbek. Ufimtsev showed that the use of the edge wave method (MKV) can assist in deriving more general results. The use of the geometric theory of diffraction (GTD) yields good agreement with experiment only at small angles of cone aperture. Within the framework of GTD, it is impossible to produce proper second approximation near the axis. MKV is more general for solving the problem near the axis than methods used by Ross, Ryan et al. or Senior et al. Figures 7; references 12: 3 Russian; 9 Western.

[230-8617]

## DETERMINING ANISOTROPY OF INHOMOGENEITIES OF THE INDEX OF REFRACTION BY USING A HORIZONTAL AND A VERTICAL INTERFEROMETER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1204-1207 manuscript received 11 Nov 77

RAKITIN, B. V.

[Abstract] The author considers the frequency spectrum of turbulent fluctuations of phase difference of radio waves in an interferometer with propagation in the ground layer of the atmosphere where turbulence is anisotropic, and the transport of inhomogeneities is horizontally directed. It is assumed that the interferometer is arbitrarily oriented in the plane perpendicular to the transmission path. Expressions are derived for the structure function and the spectrum of phase difference fluctuations that can be used to estimate the coefficient of anisotropy of inhomogeneities of the index of refraction in the ground layer of the atmosphere from simultaneous measurements in a vertical and in a horizontal interferometer. This coefficient turned out to be about 1/70 for observation times on the order of 24 hours. Figures 1; references: 4 Russian.

[244-6610]

USSR

UDC: 621.3.032.213.23

## EVAPORATION OF DISPENSER CATHODES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1184-1186 manuscript received 20 Mar 78

SHNYUKOV, V. F., MIKHAYLOVSKIY, B. I., LUSHKIN, A. YE., ZUYEV, A. YE. and RAKITIN, S. P.

[Abstract] The emission properties of dispenser cathodes are enhanced by application of refractory metal films. It has been assumed that this effect is due to increased density of crystallites on the cathode surface, leading to better evaporation of the impregnant. However, some research has shown that such films reduce the fluxes of impregnant from the dispenser cathode surface. Therefore this paper examines the influence that refractory metal films have on the rate of evaporation of impregnant components from dispenser cathodes. The metal sponge was made from a mixture of Re and W in a percent ratio of 80:20. Porosity was 25-27 percent. The impregnant was barium-calcium aluminate with composition of  $3\text{BaO} \cdot 0.5\text{CaO} \cdot \text{Al}_2\text{O}_3$ . The Os-Ir-Al films were applied in a thickness of  $0.3 \mu\text{m}$ . Rates of evaporation were continuously monitored with heating to different temperatures. The results shown conclusively that the rates of evaporation are higher for coated cathodes at the same temperature. This effect can be explained satisfactorily by the idea of crystallites on the metal surface. Figures 1; references: 8 Russian.

[244-6610]

USSR

UDC: 621.3.032.21:537.533.2

# SOURCES OF THE APPEARANCE OF LOW-FREQUENCY NOISE OF MIM CATHODES

Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian No 5, 1977 pp 1014-1019  
manuscript received 15 Feb 78

VOROB'YEV, M. D. and SMIRNOV, L. P.

[Abstract] The emission characteristics of thin-film cold cathodes of the metal-insulator-metal type (MIM) have been widely investigated. Two kinds of emission have been distinguished: anomalous, which occurs at low voltages on the MIM-cathode and is local in nature, and normal, which appears at higher voltages and derives from the entire cathode surface. An MIM-cathode based on Kovar-silicon oxynitride-aluminum, produced on the polished end of a Kovar cylinder serving as the bottom electrode, was investigated. A comparison of emission and electroluminescence proves that emission centers are simultaneously electro-luminescent centers. There is a certain correlation between electroluminescent intensity and electron emission, suggesting that these processes are related. Emission is of a local nature in the entire range of voltages investigated. The authors thank G. A. Vorob'yev of MIM cathodes and discussion of the results of the work. Figures 2; references 8: 4 Russian, 4 Western.

[230-8617]

USSR

UDC: 621.3.032.269.1

# EXPERIMENTAL INVESTIGATION OF ELECTRON GUN WITH LONGITUDINAL COMPRESSION IN A LONGITUDINAL MAGNETIC FIELD

Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 24, No 5, 1979 pp 1020-1023 manuscript received 24 Jan 78

ZINCHENKO, B. N. and LYAPKALO, YU. M.

[Abstract] In order to produce high-perveance electron beams, magnetron guns and guns with longitudinal compression are used. In the latter, in contrast to magnetron guns, the cathode is protected against ion bombardment because of an ion trap. The design and manufacture of triode guns is simpler than magnetron ones, and thus an electron gun with longitudinal compression was constructed in order to produce a gun of significant length. It had been considered that such guns could not operate satisfactorily in a magnetic field, but the results prove that the presence of a magnetic field only leads to a negligible decrease in the beam's coefficient of current passage. The gun cathode was made of lanthanum

hexaboride attached to a tantalum holder; other elements of the cathode assembly were made of molybdenum. Pulse width was 400 microseconds and the pulse repetition rate was 5/second. The gun was operated and tested in both a longitudinal increasing magnetic field (field near cathode about 200 A/m) and uniform magnetic field (about 1100 A/m). In both cases, beam  $\Phi$  was about 10 millimeters. The results prove that electron guns with longitudinal compression can operate well in a longitudinal magnetic field with relatively small values of the ratio  $V_1/V_2$ . The coefficient of current passage of the beam, though lower than in beams operating without a magnetic field, is sufficiently high. Figures 5; references: 7 Russian.

[230-8617]

USSR

UDC: 621.3.032.269.1

# AN ELECTRON GUN FOR FORMING A HIGH-PERVALENCE DISK BEAM

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1413-1418 manuscript received 7 Aug 78

ZINCHENKO, N. S. and STASENKO, V. D.

[Abstract] An electron gun has been designed and built to form a radial convergent beam interacting with a microwave field which has both axial and plane symmetry. The tubular collector is at the center of the gun and is an integral part of it. Concentrically located are the cylindrical cathode with an annular groove nesting a heater coil, the accelerating cylindrical split diaphragm and the retarding cylindrical split diaphragm-housing. Ceramic insulators are provided, and water cooling for the collector. The expressions for calculating the beam current and the beam perveance are based on a disk geometry and derived from relations for a diode with both diaphragms at the same potential. The device was tested with the accelerating potential varied from 300 to 1200 V and the retarding potential varied from 50 to 700 V. From performance measurements were obtained constant-current curves of the accelerating potential, the beam perveance, and the collector current efficiency as functions of the retarding potential, as well as beam and collector current-voltage characteristics. The results indicate that the current efficiency depends on the collector alignment and, even in the case of a poor alignment, can be increased by raising the collector potential relative to the retarding diaphragm. The current density is higher near the collector, and a high perveance is attained by flattening the beam. Figures 5; references 20: 18 Russian, 2 Western.

[273-2415]



## SYNTHESIS OF AN ELECTRON BUNCH IN A TRANSIT-TIME KLYSTRON

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1389-1395 manuscript received 23 Oct 78

MALYKHIN, A. V. and PETROV, D. M.

[Abstract] A design problem pertaining to multicavity klystrons is considered, namely synthesis of the electron velocity and beam density distributions which will yield a given operating efficiency. The problem is solved backward, i.e., beginning from the last cavity in the output stage and by determining the electron velocities at the entrance to the input gap as well as the microwave-voltage phases to which they must correspond so that all electrons will leave the input gap at the same velocity. The necessary subsequent bunching is then determined on the basis of isotachs for specific microwave-voltage amplitudes and dimensionless "plasma" frequencies, assuming a 90° transit angle, also the phase trajectories. It is further possible to optimize the thus synthesized velocity and density distributions with respect to energy output characteristics. Figures 7; references: 2 Russian.

[273-2415]

## NONLINEAR THEORY OF A RELATIVISTIC CYCOTRON

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 22, No 6, 1979 pp 754-763 manuscript received 3 May 78

GINSBURG, N. S. and NUSINOVICH, I. S., Institute of Applied Physics, Academy of Sciences USSR

[Abstract] In the gyrotron, one of the most promising types of cyclotron resonance masers, the flux of electrons rotating in a static magnetic field excites an rf field in a section of a weakly irregular waveguide. In this paper the authors analyze the conditions for effective operation of a relativistic gyrotron with a fixed rf field structure. It is shown that when the rotational energy of electrons is not excessive, the relativistic gyrotron is described by the same equations as in the case of a weakly relativistic beam. The equations of a relativistic gyrotron with large rotational energy of particles reduce to the equations of a Cherenkov TWT. The efficiency of the relativistic gyrotron falls off with increasing energy, but remains appreciable even at ultrarelativistic particle velocities. The cavity length and beam current of the relativistic gyrotron that optimize efficiency are determined. Figures 4; references 13: 12 Russian, 1 Western.

[251-6610]

## ELECTRON WAVES IN TRANSCENDENTAL PERIODIC STRUCTURES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1380-1388 manuscript received 18 Jul 78

OSIN, A. V. and SOINTSEV, V. A.

[Abstract] Interaction between the electron beam and the electromagnetic field in transcendental periodic structures is considered, such structures operating beyond cutoff and used as decoupling or modulating components in traveling-wave power tubes. Analysis of this interaction is based on certain combinations of equivalent-circuit coupling impedances between space harmonics in synchronism with the electron beam, and on the characteristic equation of electron waves. The problem is to determine the appropriate combinations of coupling impedances which remain purely resistive beyond cutoff and finite at the cutoff frequency. Such combinations have been determined for a comb structure. Here they are determined for a comb with a baffle, assuming an infinitely wide structure with infinitesimally thin teeth. Figures 2; references 14: 9 Russian, 5 Western.

[273-2415]

## ANALYSIS OF BASIC ENERGY CHARACTERISTICS OF AN OROTRON IN THE NONLINEAR MODE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1164-1169 manuscript received 21 Nov 78

TSEYTLIN, M. B., BERNASHEVSKIY, G. A., KOTOV, V. D. and NUTOVICH, L. M.

[Abstract] Preliminary analysis of the operation of orotron type devices has shown that when the space charge is disregarded in the high-amplitude operating region, and the distance dependence of the rf field of the fundamental waveform is gaussian, the electronic efficiency may reach values of more than 50 percent, which is considerably better than a resonant TWT oscillator with a wave of fixed amplitude through the interaction space. This can be attributed to the fact that beam modulation in the orotron takes place in the region of weak field amplitude, and energy is coupled out in the region of high amplitudes. In this paper, the principal characteristics of devices of this type in the nonlinear mode are analyzed in more detail. Major emphasis is placed on determining the optimum values of the geometric and electrical parameters to maximize efficiency. The analysis is done with consideration of the space charge field. An investigation is made of

the feasibility of improving efficiency by a jump in the phase velocity of the wave propagating along the slow-wave system. The efficiency and output power are determined as a function of the beam current with regard to losses in the resonator. It is shown that for optimum values of geometric parameters corresponding to maximum electronic efficiency, the efficiency and output power show hysteresis dependence on current. Conditions are found where current hysteresis is eliminated. Figures 5; references: 2 Russian.

[244-6610]

USSR

UDC: 621.385.632.19

#### EFFECT OF ELECTRON BEAM FLUCTUATIONS ON THE PERFORMANCE OF AN OROTRON

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1396-1404 manuscript received 24 Oct 78

RUSIN, F. S. and SINENKO, L. /.

[Abstract] In an O-type device one cause of transverse perturbations of the electron trajectories in a transverse magnetic field of finite intensity is interaction of the electron beam with the transverse electric component of the high-frequency field. Here it is demonstrated that this component has a negligible effect on the performance of an orotron. Another cause of transverse beam fluctuations is the lens effect of the anode gap. With the equation of motion for electrons in a ribbed beam and with the energy relations in the interaction space, disregarding the space charge, the interaction power is calculated as a function of the relative distance from the anode gap to the periodic comb structure and as a function of the magnetic field strength relative to the minimum induction. Also the starting current is calculated as a function of the distance from the periodic comb structure to the electron beam. The results suggest the optimum geometry of the electron-optic system, namely the emitting surface of the cathode should be located symmetrically with respect to the anode gap and the plane of the periodic comb structure in the case of a thick electron beam. As the thickness of the electron beam is decreased, the lower edge of the emitting surface of the cathode should be nearer to the center of the anode gap and to the surface of the periodic comb structure. The minimum magnetic field strength at the generation threshold can be lowered by widening the gap between cathode and anode, as long as the necessary current density can also be maintained. This minimum magnetic field strength rises with higher frequency proportionally, depending on the operating current, to either the quarter-power or the half-power of the latter. Figures 4; references: 3 Russian.

[273-2415]

USSR

UDC: 621.372.837:621.382

## SEMICONDUCTOR GATE FOR SUBMILLIMETER WAVES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1979 pp 1095-1097 manuscript received 29 Mar 77

LAURINAVICHYUS, A. K.

[Abstract] Recent investigations of magnetoplasmic effects in semiconductors showed that they can be employed to create semiconductor gates for the millimeter and submillimeter ranges. A semiconductor gate based on cyclotron resonance was shown to work efficiently. Requirements for the magnitude of the magnetic field in the submillimeter range of waves are greatly reduced, because observations of cyclotron resonance are adequate to meet the conditions  $\omega_c = \omega$  and  $\omega_c \tau = \omega \tau$  greater than unity. Attenuation of waves with opposite circular polarization, determined by the virtual portion of dielectric permeance, will be different. Under conditions of cyclotron resonance, electromagnetic waves with polarization corresponding to this resonance will be intensely absorbed. Waves with opposite circular polarization will pass through almost without attenuation. The non-reciprocity of the gate can be varied widely by selecting the concentration and mobility of free charge carriers. Figures 3; references 5: 1 Russian, 4 Western.

[230-8617]

USSR

UDC: 621.373.072.9

## SYNCHRONIZATION OF MODULATED SELF-OSCILLATIONS BY MEANS OF A SMALL HARMONIC SIGNAL

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1374-1379 manuscript received 26 Jul 76

SKUPOY, V. V.

[Abstract] Synchronization of self-oscillators with external periodic modulation is considered, of particular interest being pulse modulation. The general second-degree differential equation describing such an oscillator  $\ddot{u} + \omega_0^2(u, M) = f(u, \dot{u}, M) + e$  (where  $u$  is the voltage across the tank circuit,  $M$  is the modulating action, and  $e$  is the synchronizing signal) can be replaced with a system of two first-order equations. These are solved here for a harmonic synchronizing signal  $e = E \sin \omega_c t$ , synchronism being defined as the condition where the set of frequencies in the spectrum of a separately excited oscillator is isomorphous with the set of frequencies in the self-

oscillation spectrum and the latter includes frequency  $\omega_c$  with the signal component at this frequency shifted in phase by a definite constant angle from the external  $\omega_c$ -signal. The equations are solved by the averaging method and the problem is thus reduced to synchronization of an unmodulated self-oscillator. Calculations and experimental data are shown for a transistor oscillator with a feedback through a transformer. Calculations are based on a simple equivalent parallel circuit and measurements are based on Lissajoux figures on an oscilloscope. The author thanks I. KH. RIZKUN for the comments which have greatly contributed to a better report. Figures 4; references 11: 7 Russian, 4 Western.

[273-2415]

USSR

UDC: 621.382.22.029.64

#### EXPERIMENTAL STUDY OF HARMONIC MIXERS AT SUBMILLIMETER WAVELENGTHS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1471-1473 manuscript received 13 Mar 78

AVERIN, S. V. and POPOV, V. A.

[Abstract] A theoretical analysis of mixers based on Schottky-barrier diodes indicates that harmonic mixing improves the performance characteristics in the submillimeter range. For an experimental verification, planar epitaxial n-GaAs diodes (electron concentration  $2 \cdot 10^{17} \text{ cm}^{-3}$ , electron mobility  $3500 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$ , series resistance  $27 \Omega$ , saturation current  $10^{-15} \text{ A}$ , diameter  $2 \mu\text{m}$ ) were placed in a cruciform waveguide as the mixer chamber. The signal power was measured with an n-InSb receiver at 4.2 K, the conversion losses were measured by the heterodyne method. With the heterodyne signal frequency equal to 64 GHz, the conversion losses ranged from 10.4 dB at the second harmonic (compared to theoretical 7 dB) to 30 dB at the sixth harmonic. While these losses are not much higher than in the case of fundamental mixing, the noise factor in the receiver is much lower. With a harmonic mixer, furthermore, it becomes feasible to build a submillimeter-wave superheterodyne receiver with a solid-state pumping generator. Tables 1; references: 4 Russian.

[273-2415]

USSR

UDC: 621.396.6.53.088.3

## DISTRIBUTIONS OF PARAMETER VALUES OBTAINED BY MULTIPLE TESTING OF A DEVICE

Moscow RADIOTEKHNIKA in Russian Vol 34, No 7, Jul 79 pp 28-30 manuscript received 19 Jun 78

SAVIN, S. K.

[Abstract] Multiple inspection of devices in the production process and then in service is done for quality and performance control. Here the statistical distribution laws are formulated for the parameter values which characterize the first and the n-th measurements, as well as for the limiting case of an infinite number of measurements (inspections) with the dispersion of values tending to zero. The variance field is found to be narrower than in the case of acceptance and rejection based on the mean value in a single measurement (inspection). Figures 2; references: 4 Russian.

[270-2415]

USSR

UDC: 669.14+62-418:620.179.1+538.5

## CALCULATION OF THE DEFECT FIELD OF A STEEL BAND IN THE CASE OF LONGITUDINAL MAGNETIZATION

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 79 pp 573-576 manuscript received 16 Jul 78

KSYUNIN, ANATOLIY GEORGIYEVICH, candidate in technical sciences, docent, and SVEKOLKIN, ALEKSANDR L'VOVICH, candidate in technical sciences, senior instructor. Novocherkassk Polytechnical Institute

[Abstract] A method is proposed for calculating the component of the magnetic induction vector that is normal to the surface in the vicinity of a defect as a basis for magnetic flaw detection in quality control of ferromagnetic materials. The scattering field of the defect is calculated by direct integration with respect to sources for a flaw analogous to a fatigue crack in a steel band magnetized in the longitudinal direction. A formula is derived that can be used to determine the necessary intensity of magnetization, sensitivity of measuring equipment, the parameters of the sensor for detecting the scattering field, effective placement of the sensor over the surface to be inspected, linear dimensions of flaws, and location relative to the sensor. The results agree well with experimental data. Figures 1; references: 6 Russian.

[276-6610]



USSR

UDC: 001.8:534.61

# ERRORS OF THE CORRELATION METHOD OF MEASURING THE SIGNAL PARAMETERS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian, No 3, Mar 79 pp 33-35

MALYKIN, M. I.

[Abstract] The parameters of a signal submerged in white noise are measured by a correlation method which involves evaluation of correlation integrals in the instrument. The measurement error in this case consists of one statistical component due to the finite integration interval and one periodic component due to the appearance of a double-frequency voltage at the correlator input. Here the latter, occurring in phase and amplitude measurements, is analyzed. The correlation integrals are derived on the assumption of a zero input noise and correction for this noise is considered subsequently. While the periodic error due to phase fluctuation is removable by proper choice of the integration interval in the absence of noise, it is not completely removable at a signal-to-noise ratio equal to or smaller than 1/2 and is negligible at a signal-to-noise ratio equal to or larger than 2. Figures 3; references: 3 Russian.

[248-2415]

USSR

UDC: 534.2.22

# A FACILITY FOR EXACT MEASUREMENT OF THE SPEED OF ULTRASOUND BY THE METHOD OF PULSE MATCHING

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 pp 148-150 manuscript received 13 Jan 78

ANTONENKO, A. M. and VOLNYANSKIY, M. D., Dnepropetrovsk State University

[Abstract] A unit is described for precision measurements of the speed of ultrasound based on a principle of measuring the time of passage of ultrasound through a specimen by superposition of echo pulses on an oscilloscope screen. The measurement results are read out on a Ch3-34 frequency meter that measures the period of the signal. High measurement accuracy is achieved by matching the periods of the echo signals. Matching the  $n$ -th reflection with the  $m$ -th gives the time necessary for  $m - n$  double passages of an ultrasonic pulse in the specimen. An estimate of the error of measurement of the time interval  $T$  required for double passage of ultrasound gives a value of  $2 \cdot 10^{-4}/T$ . The device was verified on a fused quartz specimen. Sensitivity tests show that the device can detect a relative change in the speed of ultrasound of the order of  $10^{-5}$ . Figures 2; references 4: 2 Russian, 2 Western.

[261-6610]

AUTOMATIC INSPECTION OF ANALOG-TO-DIGITAL AND DIGITAL-TO-ANALOG CONVERTERS  
FOR THEIR DYNAMIC CHARACTERISTICS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian, No 4, Apr 79 pp 25-26

BRAGIN, A. A., SEMENYUK, A. L., BORODATYY, V. I. and KONOVALOV, V. I.

[Abstract] Automatic test stands are being developed at the All-Union Scientific-Research Institute of Measurement Information and Control Systems for inspection of analog-to-digital and digital-to-analog converters, particularly their dynamic characteristics. Such a test stand includes a precise-amplitude pulse generator, a generator of precise time intervals, a stroboscope, a high-precision a.c. voltage source, and a high-precision high-speed decoder. It measures the trigger delay time, the coding-cycle period, and the total conversion time of analog-to-digital converters, which determine the maximum feasible triggering frequency of these devices. It also measures the "aperture" time of analog-to-digital converters, i.e., the spread of delay time error, which determines the error of conversion at any given instant of time. It measures, furthermore, the transient time of digital-to-analog converters. All these parameters are defined in standard terms and their measurement is based on a standard performance analysis of a linear input-output device responding respectively to a sinusoidal or a binary signal. The measurements are controlled and the readings are processed by a minicomputer through an interface built in accordance with IEC standards. These test stands are designed for devices rated 0-10 V and 0-1 mA, conversion time 0.5-100  $\mu$ s and transient time 0.1-100  $\mu$ s, with a resolution of 8-12 binary digits. An automatic test stand for integrated-circuit digital-to-analog converters can measure the transient time of 8-12 digit devices within the 0.4-4  $\mu$ s range. Figures 3.

(19-541)

## A NON-CONTACT ELECTRIC VOLTAGE INDICATOR WITH DIGITAL READOUT

Moscow PRIBORI I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 p 237  
manuscript received 5 Jan 78LITVIN, L. P., KOKOVIKHIN, V. G., KOTUNOV, A. A., MAL'CHENKO, K. P.,  
MELNIK, A. I. and YAKOVLEV, N. I.

[Abstract] A brief description of a voltage indicator for checking electronic equipment based on integrated circuitry. The indicator is a: updated version of the P7079 with visual threshold indication. The device

has a capacitive remote sensor. Measurement results are read out from a digital display. The instrument provides digital threshold indication of a periodic pulse sequence that covers the range of signal levels of most IC logic devices. The error of the digital threshold display does not exceed 2 dB for a range of pulse recurrence rates from 1 Hz to 500 kHz, rise time and fall time of 150 ns, and variation of insulation thickness of 150  $\mu$ m. The linear resolution of the sensing element in the probe allows measurements with spacing between components down to 1.25 mm with attenuation of at least 20 dB for interference from adjacent leads. The device operates from a 220 VAC 50 Hz line or a 3336L battery. The current taken from the battery does not exceed 0.15A. The indicator measures 230 x 230 x 60 mm, and weighs less than 3 kg. Figures 1.

[261-66111]

1988

UDC: 621.317.37

#### AN AUTOMATIC INSTRUMENT FOR MEASURING THE AMPLITUDE-PHASE STRUCTURE OF THE FIELD IN OPEN RESONATORS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 pp 135-136 manuscript received 5 Jan 78

(V.M. GUSEV), I. V., Institute of Radio Physics and Electronics, UkrSSR Academy of Sciences, Khar'kov

[Abstract] An automatic system is described for measuring the amplitude-phase distribution of the field in an open resonator with synchronous registration in the millimeter and submillimeter wave bands. The phase distribution is obtained by conversion of information from microwave frequencies to a lower intermediate modulation frequency. Amplitude-phase distributions are shown for the fundamental wave in a semisymmetric open resonator at a wavelength of 4.2 mm. Measurements can be made both on the fundamental waveform and on higher harmonics. The maximum error of phase measurements is no more than 10 percent. Figures 2; references: 7 Russian.

[261-66111]

## METHODS OF MEASURING HIGH RESISTANCES

Moscow IZMERITEL'NAYA TEKHNIKA in Russian, No 3, Mar 79 pp 25-28

ILYUKOVICH, A. M.

[Abstract] For measurement of high resistances are now used 3-arm terohm-meters including an amplidyne, with either a preset voltage totally applied across the unknown resistor or a preset current totally passed through it, and 4-arm bridges. Other possible instruments are capacitive meters with an air or metal-film capacitor replacing the high-resistance element in the reference arm and resistive-capacitive meters with a low-resistance trimmer in addition to the capacitor. A comparative analysis of all these methods with respect to accuracy and sensitivity reveals that the existing resistive instruments cannot ensure high accuracy and high sensitivity at the same time but rather a tradeoff. Capacitive instruments are better and resistive-capacitive ones are best. Both can be built with a continuous output signal or with a 2-stage conversion of resistance to output signal. In the latter case the accuracy is particularly high, but here transients limit the range of measurement to  $10^{12} \Omega$  maximum. Figures 3; references 5: 4 Russian, 1 Western.

[248-2415]

## FEEDERLESS METHOD OF MEASURING THE INTENSITY OF AN ELECTROMAGNETIC FIELD

Moscow IZMERITEL'NAYA TEKHNIKA in Russian, No 3, Mar 79 pp 47-48

MELEKHOV, M. YE., RYZHKOV, I. I. and TISHCHENKO, V. A.

[Abstract] An instrument probe has been designed for measurement of the electric field component without a feeder and thus without errors due to pickup. The probe is based on a spherical antenna consisting of two solid hemispheres with a diametrical gap which form a radial line and terminate into a coaxial line with a load at the other end. A performance analysis of this device indicates the feasibility of measuring local electric field intensities with the signal receiver located inside the antenna, also when the radius of the latter is much smaller than the wavelength of the electromagnetic field. A typical such spherical antenna is 100 mm in diameter with a 3 mm wide gap and with an inductor used as the load. The receiver includes a diode peak detector and a differential dc transistor amplifier.

The probe can also measure the absolute values of electric field intensity, inasmuch as the input parameters of a spherical antenna are known. With an amplifier gain higher than  $5 \cdot 10^4$  and a threshold voltage of 400 mV, the response error is less than 0.1 percent. Figures 2; references 6: 2 Russian, 4 Western.

[248-2415]

USSR

UDC: 621.317.335.3:621.3.029.66

# OPTIMIZING THE MEASUREMENTS OF DIELECTRIC PROPERTIES OF SUBSTANCES AT SUB-MILLIMETER WAVELENGTHS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1405-1412 manuscript received 27 Dec 77

VOLKOV, A. A., KOZLOV, G. V. and LEBEDEV, S. P.

[Abstract] Determination of the refractive index  $n$  and the absorption coefficient  $k$  of dielectric substances from measurements of the transmission coefficient  $T$ , the reflection coefficient  $R$ , and the respective phase shifts  $\varphi_T, \varphi_R$  is considered. In submillimeter-wave spectroscopy it is most appropriate to use plane-parallel plate specimens and normally incident radiation, also carefully accounting for diffraction and interference effects. Here the errors  $\Delta n$  and  $\Delta k$  of these measurements and subsequent calculations, on the basis of difference-derivative relations and with the aid of  $k$ - $n$  diagrams, are analyzed relative to four possible methods and the results used for selecting the best method in specific situations. Method " $T_1$  and  $T_2$ " (two  $T$  measurements) is least accurate but very simple, suitable for rough estimates. Method " $T$  and  $\varphi_T$ " is most accurate and optimal when  $kd/\lambda = 0.2$ , method " $T$  and  $R$ " is sufficiently accurate when  $n$  is much smaller or much larger than  $k$  and optimal when  $kd/\lambda = 0.3$  ( $d$  denoting the specimen thickness and  $\lambda$  denoting the wavelength). Method " $R$  and  $\varphi_R$ " is most complex, impractical for low values of  $k$  but convenient for high values of  $k$ . The authors thank N. A. IRISOVA for interest in this study and V. V. MERIAKRI for helpful comments. Figures 7; tables 1; references 13: 8 Russian, 2 German, 3 Western.

[273-2415]

## AN INSTRUMENT FOR MEASURING THE DIELECTRIC PARAMETERS OF SUBSTRATES

Moscow IZMERITEL'NAYA TEKHNIKA in Russian, No 3, Mar 79 pp 40-41

GERASKIN, V. S., GUDKOV, O. I., POTAPOV, A. A., FEDOTOV, V. A. and LAVRENOV, B. A.

[Abstract] An instrument has been built for measuring the dielectric parameters of substrates for microwave printed-circuits. It measures the real part of the relative dielectric permittivity from 2 to 12 with the basic error within 1.5 percent and the  $\lg \epsilon$  tangent from  $1 \cdot 10^{-4}$  to  $1 \cdot 10^{-3}$  with an error not exceeding  $(20 + \frac{0.01}{\tan \delta})$  percent. Both measurements are based on the simple dependence of the relative change of resonance frequency, upon insertion of a specimen into the air gap, on the specimen thickness referred to the resonator length and on the dielectric permittivity (its real part) of the specimen material. The instrument consists of a thickness gauge, and indicator and a primary transducer, all with electronic circuitry and automation. The time of one measurement is not longer than 5 s and the repeatability of results is not worse than 0.5 percent. Figures 1; references: 2 Russian.

[248-2415]

## A DIGITAL INSTRUMENT FOR MEASURING THE TIME PARAMETERS OF RADIO PULSES

Moscow IZMERITEL'NAYA TEKHNIKA in Russian, No 3, Mar 79 pp 44-45

BELOZEROV, I. A., TSIKHON, V. N. and SUKONKINA, YE. A.

[Abstract] A digital instrument for measuring the time parameters of radio pulses is proposed which compares points on the pulse envelope with constant levels at various fractions of the pulse amplitude. Such measurements are more accurate than readings on an oscillograph. The instrument consists of a synchronizer and an amplitude analyzer which yields separate readings of pulse top and pulse pause, followed by a bistable trigger and two coincidence circuits for separate readings of risetime and falltime respectively. The synchronizer, together with an inverter, constitutes a Schmitt trigger. The instrument error consists of discrimination errors, discretization error, frequency instability and errors in determining the maximum signal amplitude. Figures 3; references: 3 Russian.

[248-2415]



## ESTIMATING THE ERROR OF DIGITAL VOLTMETERS DURING THEIR INSPECTION

Moscow IZMERITEL'NAYA TEKHNIKA in Russian, No 3, Mar 79 pp 28-32

KASHLAKOV, V. M.

[Abstract] The systematic instrument error of digital voltmeters is the object of their inspection and here its estimation is analyzed, with the transition boundary between a code and the next preceding or following one regarded as the checkout point. A probability analysis of the discrete estimation process yields the error distribution, which can be fitted unilaterally from the high side or the low side and also bilaterally. The statistical characteristics of such estimates, namely their mathematical expectation and standard deviation, as well as the estimation time are calculated for various possible situations, taking into consideration the effects of random error and of variation in these digital instruments. Figures 4; references: 6 Russian.

[248-2415]

## A METHOD OF AUTOMATIC INSPECTION FOR DIGITAL VOLTMETERS WITH TIME-TO-PULSE CONVERSION

Moscow IZMERITEL'NAYA TAKHNIKA in Russian, No 3, Mar 79 pp 32-33

DZYUBA, A. V.

[Abstract] A method of automatic inspection is proposed for digital voltmeters which allows for not just mere tolerance checking but determination of the true error. The error estimate is referred here to the output signal so that inspection will not depend on the ratio of quantization step to error or its mean-squared deviation. Furthermore, supplementary decimal quantization of the start-stop signal make it possible to locate the end of this signal within a quantization step with any desirable precision. The mathematical expectation of the random component of the instrument error is calculated according to conventional formulas. This method is suitable only for digital voltmeters with output leads for the necessary test signals, which currently manufactured one do not have, and thus only for in-process rather than final inspection. Figures 2; references: 1 Russian.

[248-2415]

## A PHASE METER WITHOUT FREQUENCY CONVERSION FOR THE BAND BETWEEN 20 Hz AND 60 MHz

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 pp 137-140 manuscript received 24 Jan 78

FISHTEYN, A. M., Institute of Physics, Siberian Department, Academy of Sciences USSR, Krasnoyarsk

[Abstract] Because of desirable features in the construction and operation of phase meters without frequency conversion, research is being done to extend the range of such devices. Current instruments are available that can measure phase differences without frequency conversion up to about 10 MHz. A phase meter of this type is described in this article that is as accurate up to 60 MHz as conventional instruments that operate in the 1-2 MHz band, and provides much better precision in the frequency band below 1 MHz. The proposed meter has two limiter amplifiers in each stage, one for frequencies below 10 MHz, and one for frequencies above this level. This increases the bandwidth of the device by minimizing the isolating capacitances in the high-frequency clipper amplifier and accordingly reducing the parasitic capacitances that shunt the loads of the amplifier stages. In the dynamic range of input signal amplitudes above 60 dB the error of the phase meter does not exceed  $0.2^\circ$  in the frequency range from 20 Hz to 1 MHz, increasing to  $3^\circ$  at a frequency of 60 MHz. IN the case of input signals of equal amplitude, the range of the meter is extended from 5 Hz to 100 MHz. At frequencies below 20 Hz, the time constant of the filter at the input to the digital voltmeter should be increased by a factor of 4-5. Figures 1; tables 3; references 7: 6 Russian, 1 Western.

(261-6610)

## RECEIVER EQUIPMENT FOR HIGH-PRECISION MEASUREMENT OF THE CARRIER FREQUENCY OF AMPLITUDE-MODULATION SIGNALS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian, No 3, Mar 79 pp 37-38

MONTSIKOWICH, Z. I., PAS'KO, E. V. and VLASENKO, O. P

[Abstract] Contactless measurements with receiver instruments contribute to a higher reliability of radioelectronic devices in communication, navigation, telemetry and remote control. Here such a receiver for measuring the

carrier frequency (100-400 MHz) of AM signals is shown which includes, in addition to one h-f amplifier stage, three mixer stages, three i-f amplifier stages, a heterodyne with automatic frequency control, a signal limiter-shaper, and a phase detector, also an electronic-counter frequency meter with phase-type automatic frequency control and an arithmetic unit with digital display. The switch is also electronic. These features contribute a high degree of interference immunity and a high response speed as well as sensitivity (10  $\mu$ V) and selectivity, with a bandwidth of at least 30 kHz at the 0.5 level and at least 140 kHz at the 0.001 level. The measurement error does not exceed  $10^{-5}$  percent. Figures 1; references: 4 Russian.

[248-2415]

USSR

UDC: 621.374.387:621.314.26

PROBLEMS IN STANDARDIZING AND EXPERIMENTALLY DETERMINING THE DYNAMIC CHARACTERISTICS OF MEASURING INSTRUMENTS WITH A PULSE-FREQUENCY MODULATION OF THE OUTPUT SIGNAL

Moscow IZMERITEL'NAYA TEKHNIKA in Russian, No 4, Apr 79 pp 27-28

KNORRING, V. G., KNORRING, L. N., MALYGINA, N. V., MARAMZINA, M. G., BENCHUKOV, V. V. and YASIK, YA.-R.

(Abstract) Much work has been done at the Leningrad Polytechnic Institute on analysis, design and application of measuring instruments with pulse frequency modulation of the output signal. These instruments include two subclasses: voltage-to-frequency converters and pulse frequency multipliers. An important part of this research and development program is standardization and experimental determination of the dynamic characteristics, necessary for establishing the variation of pulse frequency with time and for selecting either an ideal device model or a reference signal as the means of evaluating real devices. For simulation purposes, the pulse frequency can be represented either as a sequence of  $\delta$ -functions coincident with the signal pulses or as a continuous function of time. Although idealization of voltage-to-frequency converters is simple, unlike idealization of pulse frequency multipliers, a comparison of output signals could be based only on the timing of pulses. Therefore, the dynamic characteristics of voltage-to-frequency converters are measured preferably by correlation methods with logic multiplication and with counting instead of integrating. The initial frequency can be accounted for by a summing circuit and a source of bias voltage at the input. For determining the dynamic characteristics of pulse frequency multipliers, on the other hand, are required a master oscillator which controls the pulse generator and a

reference device for M-th pulse sampling as well as a pulse comparator and a data processor for separating the systematic error from the random error. References 10: 9 Russian, 1 Western.

[259-2415]

USSR

UDC: 621.382.3

# INDIRECT MEASUREMENT OF 'HOT SPOT' TEMPERATURES IN TRANSISTOR STRUCTURES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1473-1474 manuscript received 29 Nov 78

FEDOTOV, YA. A., PEREL'MAN, B. L., DOROSHENKO, L. G., KERNER, B. S. and MININ, V. F.

[Abstract] The temperature distribution in most high-frequency power transistors is nonuniform and the "hot spot" critically affects the performance. Since accurate direct measurement of the "hot spot" temperature requires a rather complex instrumentation, an indirect method is proposed here which utilizes the dependence of the emitter-base voltage  $V_{eb}$  on the "hot spot" temperature  $T_{hs}$  and yields a 7-10 percent accuracy. It has been established experimentally that this dependence becomes linear when the transistor temperature and its distribution change (at a constant case temperature) upon an increase of the collector current (at a constant collector-base voltage). The slope  $B=dV_{eb}/dT_{hs}$  can be estimated on the basis of an equivalent structure consisting of the "hot spot" in parallel with the remainder of the emitter surface. This coefficient for various transistors (KT904A, KT921A) has been found to be independent, within 5 percent, of the collector current and to remain constant within 7 percent over a wide range of collector test voltages. There is also a definite numerical correspondence between this slope and the temperature coefficient of emitter voltage, at low collector test currents. Figures 1; references: 2 Russian.

[273-2415]

## CHARACTERISTICS OF SIGNAL RECEPTION BY A SERVO-MEASURING INSTRUMENT

Moscow RADIOTEKHNIKA in Russian Vol 34, No 7, Jul 79 pp 35-37 manuscript received 24 Apr 78

FEDOSOVA, A. I.

[Abstract] The characteristics of the regulation process in a typical measuring instrument with a first-order servomechanism are established by solving the inverse Fokker-Planck-Kolmogorov equation. Accordingly, an equivalent system is considered consisting of a discriminator at the input, a smoothing filter, and an amplifier-converter at the output, with feedback from the output to the discriminator. The probability characteristic of the measurement error variable over a certain interval is estimated from the exact solution to the corresponding parabolic differential equation, such a solution being possible by virtue of a theorem which can be proved by application of the principle of the minimum. The discrimination characteristic and its slope are then calculated so that a nonlinear and a linear or two nonlinear instruments can be compared on this basis. With the length of the regulation process first defined as the time within which the mean error decreases to a certain level, the mean final error is estimated and then again the length of the regulation process as the time within which the mean final error stabilizes at a value below that level. This method yields results which duplicate those obtained by comparing the error of optimal nonlinear filtration with that of a linear filter and, furthermore, yields estimates of probability parameters when there are constraints. Figures 3; references 3: 2 Russian, 1 Western.

[270-2415]

USSR

UDC: 621.3.048.001.3

## INSULATION BASED ON HEAT-RESISTANT MICANITE MATERIAL

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 79 pp 21-23 manuscript received 9 Oct 78

ANISIMOVA, YE. K., IL'INA, O. M., engineers, and PETRASHKO, YU. K., candidate in technical sciences

[Abstract] The paper gives the properties of Soviet glass-bonded micanite material LS-KE-TT. This is an elastic insulating material of class H heat-resistance, based on micanite paper, glass fabric and silicone elastomer, and is superior to LFK-TT micaflex in dielectric characteristics and technological properties. Tests have shown the new material to be highly elastic, wear-resistant and heat-resistant. When impregnated with organo-silicon compounds after application, the material has high electrical resistance after prolonged holding in a humid atmosphere or water, and the breakdown voltage is much higher than that of LFK-TT insulation. It is recommended as a replacement for LFK-TT micaflex for insulating the armature and stator windings of DC and AC motors. Figures 3; tables 4.

(250-6610)

USSR

UDC: 621.315.2/3.002.2.004.18

## MAJOR AREAS FOR REDUCING MATERIAL INPUT IN WIRES AND CABLES

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 79 pp 5-8 manuscript received 27 Nov 78

FERHKOV, I. B., doctor in technical sciences, Director of VNIKP (All-Union Scientific Research Institute of the Cable Industry)

[Abstract] An investigation is made of ways to save copper, aluminum, lead, reinforcement banding, polyvinyl chloride and polyethylene in the cable and wire industry. An important way to save copper is by using bimetal conductors with an aluminum core and a copper outer layer. One metric ton of bimetal wire saves 1.3 metric tons of copper and provides equivalent electrical conductivity. Another way to save copper is by substituting continuous casting and rolling for the process of hot-rolling wire bars in making rolled wires. This process eliminates the waste involved in heating the wire bars before rolling and the losses in etching the copper wire, as well as saving energy and reducing the environmental impact. Installation of a continuous casting and rolling unit with a capacity of 75,000 metric tons of rolled wire per year can give an annual savings of about



850 metric tons of copper. Up to 1200 metric tons of copper can be saved for every million electric motors of the new series 4A by using high-temperature enameled wire in the windings. More copper can be saved by using aluminum windings in transformers, and also by using high-strength copper alloys and bronze for trolley wires. In cable-tire and entrance cables, copper can be saved by increasing the power-handling capacity through the use of heat-resistant insulation. Copper, polyethylene and PVC can be saved in communications cables by reducing the diameter of the conducting strands. To save lead in cable shielding, aluminum, plastic and corrugated steel sheaths can be used. Material inputs can be reduced by using thinner reinforcement banding, or by eliminating it entirely where protection is adequate without reinforcement. More rational selection of cable sizes by consumers can also save on all cable materials. Figures 4; tables 3.

[250-6610]

USSR

UDC: 621.315.14.001.4

#### USING EXPERIMENT PLANNING TO DEVELOP A HIGH-TEMPERATURE ALUMINUM ALLOY

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 79 pp 29-30 manuscript received 9 Jun 77

TELESHOV, V. V., candidate in technical sciences, and KOZLOVA, O. M., engineer

[Abstract] A multiple-factor experiment is described in which an investigation is made of the influence that various dopants have on the mechanical properties and electrical conductivity of aluminum alloys. The elements studied were Fe, Zr, Cu, B, Mg and Si. As a result of the work, an alloy was developed for electric wires with high strength properties that remain stable with prolonged operation at temperatures up to 250°C, and satisfactory electrical conductivity. This alloy contains 0.47% Mg, 0.25 percent Cu, 0.23 percent Zr, 0.13 percent Fe and 0.05% Zn. The alloy has good technological properties and can be drawn into strands down to 0.32 mm in diameter and also twisted into flexible conductors. Figures 1; tables 4; references: 5 Russian.

[250-6610]

THE USE OF NEW ELECTRICAL INSULATION MATERIALS IS A DECISIVE FACTOR IN  
IMPROVING THE SPECIFIC CHARACTERISTICS OF ELECTRIC MACHINES AND REDUCING  
MATERIAL INPUTS

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 79 pp 11-14 manuscript received  
22 Dec 78

PETRASHKO, A. I., TRUBACHEV, S. G., candidates in technical sciences,  
OGON'KOV, V. G. and SHAGALOV, S. B., engineers

[Abstract] It is pointed out that the latitude for improving insulating materials is greater than for magnetic and conductive materials. Advantages to be realized from improvements in this area include increased power, reduction of metal inputs, extended service life, savings on repair work, and mechanization and automation of insulation winding. One major improvement in insulation has been the replacement of dotted Micaflex by thermosetting resins. Improvement of heat resistance and reduction in the thickness of insulation can have a pronounced effect on the technical-economic indices of powerful high-voltage induction motors. The switch from Micaflex to thermosetting insulation is also effective for hydraulic generators, turbogenerators and low-voltage motors. Considerable advances have also been made in the use of synthetic films and papers in electrical insulation. Polyvinyl film materials combined with heat-resistant binders are very effective for special purpose-insulation (traction motors, metallurgical equipment, crane drives, explosion-proof applications). The article includes five tables summarizing the properties of various types of new insulating materials. Tables 5; references: 4 Russian.

[250-6610]

PROBLEMS OF SAVING SILVER AND SOME OTHER METALS IN ELECTRIC EQUIPMENT BUILDING

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 79 pp 9-11 manuscript received  
28 Jul 78

BRON, O. B., doctor in technical sciences, professor

[Abstract] An examination is made of the impending threat of total depletion of natural resources of metals used in electrical engineering: silver, gold, copper, platinum, aluminum, iron, nickel, lead, tin, zinc and tungsten. The most critical metal is silver, because of its important properties as well as scarcity. Most of the silver used in electrical equipment (70-80 percent) goes for making contacts in switches and relays. This silver cannot be recovered, as it is burned up by arcing. An important way to

save on this use of silver is by reducing contact areas in equipment that is underloaded. Silver should be used for contacts only in cases where other metals will not suffice. Arcless equipment and pnp-type switches should be used in heavily loaded devices. The destructive action of short-circuit currents can be minimized by using current-limiting breakers and fuses. A great deal of silver can be saved by organizing collection of worn switches, since some contacts may still contain silver when the switch is out of service. For many applications, silver can be replaced by more plentiful metals without detrimental effects. In plating applications, it may not be necessary to cover the entire component, but only the contact area. Figures 1; tables 1; references 3: 1 Russian, 2 Western.

[250-6610]

USSR

UDC: 621.762:669.004.12

#### EXTENSIVE INTRODUCTION OF CERMET ITEMS--A RESERVE FOR SAVING METALS

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 79 pp 16-18 manuscript received 17 Oct 78

AL'TMAN, A. B., doctor in technical sciences, professor

[Abstract] The use of cermet items in the electrical engineering sector is an important reserve for saving metal. The volume of cermet items produced and used in this sector doubled between 1970 and 1977, and is expected to increase by a factor of 1.5 between 1977 and 1980. In addition to saving metal, powder metallurgy can produce materials with special properties that cannot be made by conventional metallurgy and treatment. The components can be produced in final shape and size in one operation without melting and casting, which are operations that involve losses and waste. Materials can be used that are less expensive and more plentiful than the traditional metals used in electrical engineering. Examples are given illustrating the savings of metal for specific items with conversion to cermet. Figures 2; tables 1; references 5: 4 Russian, 1 Western.

[250-6610]

## COILED SHEET STEEL FOR THE MAGNETIC CIRCUITS OF ELECTRIC MACHINES

Moscow ELEKTROTEKHNIKA in Russian No 6, Jun 79 pp 18-20 manuscript received 21 Apr 79

KAZARNOVSKIY, L. SH., KONDRAT'YEV, N. V. and SMIRNOVA, L. P., candidates in technical sciences

[Abstract] Soviet industry has recently begun producing cold-rolled coiled steel sheets that are superior to the formerly produced hot-rolled transformer sheet steel used in electric machines. In comparison with the former material, the coiled steel has higher magnetic induction, lower power losses, and more precise geometry (uniformity of thickness and surface finish). Delivery of sheet steel in coils facilitates automation of parts manufacture and reduces wastage. Characteristics of coiled steels with different degrees of alloying (silicon content) are described. References: 10 Russian.

[250-6610]

USSR

## MAGNETIC TAPES FOR AMATEUR SOUND RECORDING

Moscow RADIO in Russian No 6, 1979 pp 59-60

NIKONOV, YE., DUNAYEV, A., CHUPRIN, V. and FALMAY, I.

[Abstract] A data sheet on acoustic tape for home recorders, both reel-to-reel and cassette. The electroacoustic and physicomachanical properties of tapes are summarized in tables. An explanation is given for the code designation of magnetic tapes according to GOST 17204-71 "Tapes, Magnetic": the first element is a letter indicating purpose (A--acoustic, T--video, V--computer, I--precision magnetic recording); the second element is a figure from 0 to 9 denoting the base material (for example 2--diacetate, 3--triacetate, 4--laxsan [Mylar] and so on); the third element is a figure from 0 to 9 indicating thickness (for tapes used in acoustic recording, 2--15-20  $\mu$ m, 3--20-30  $\mu$ m, 4--30-40  $\mu$ m, 5--40-50  $\mu$ m, 6--50-60  $\mu$ m); the fourth element is a figure from 01 to 99 denoting the number of the technological development; the fifth element is a number denoting the rounded width of the tape in mm. This code designation is sometimes followed by a letter indicating special characteristics: R--tapes for radio broadcasting, B--tapes for home recording equipment, and P--for punched tapes. Tables 2.

[253-6610]

USSR

UDC: 621.373.5:621.382.2

## INHERENT NOISE IN A BARITT-DIODE OSCILLATOR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1367-1373 manuscript received 3 Jul 78

ZAYTSEV, V. V. and YAKIMOV, A. V.

[Abstract] Inherent amplitude and frequency fluctuations in a BARITT-diode microwave oscillator are described here by the equivalent-circuit equations, according to the method generally applicable to self-oscillatory systems. The diode is assumed to consist of a junction zone and a drift zone, each characterized by a certain capacitance. Following an analysis of self-oscillation dynamics in an ideally noiseless device, amplitude and phase fluctuations about their steady-state values are found from the appropriate system of linear differential equations for the small-signal case. The results of calculations indicate several mechanisms affecting the noise level. As the bias current (direct component of the current injected into the drift region) increases, both the height of the amplitude fluctuation spectrum and the width of the self-oscillation spectral line decrease. The noise level rises sharply as the oscillator current increases to the starting level and it drops as the transit angle increases. It ceases to drop in the latter case, however, as the bias current further increases. Figures 2; references 10: 3 Russian, 7 Western.

[273-2415]

USSR

UDC: 621.373.42

## A SYSTEM OF MUTUAL SYNCHRONIZATION INVARIANT WITH RESPECT TO TIME DELAYS ALONG INTERCONNECTION LINES

Moscow RADIOTEKHNIKA in Russian Vol 34, No 7, Jul 79 pp 32-34 manuscript received 16 Aug 78

KAYATSKAS, A. A.

[Abstract] The major drawback of existing systems designed for synchronization of oscillators is that the final steady-state frequency strongly depends on time delays along the interconnection lines. With a certain relation between the time delays, this frequency can be either higher than the highest local one or lower than the lowest local one. The effect of time delays can be minimized by means of a control signal independent of the latter, which is now done with a 2-step control system requiring additional interconnection channels. Here the algorithm of synchronization

with a control signal based on increments of phases is shown, without this disadvantage and with the final frequency much less dependent on time delays than in conventional systems. When all local frequencies are the same, moreover, the final frequency becomes entirely independent of time delays. This pertains to initial time delays only; however, changes in time delays following complete interconnection and mainly due to seasonal changes must be compensated just as in conventional synchronization systems. References 3: 2 Russian, 1 Western.

[270-2415]

USSR

UDC: 621.373.43

#### A WIDEBAND SAWTOOTH GENERATOR

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 pp 118-119 manuscript received 6 Jan 78

BELYY, A. A. and SKRIGAN, N. N., Belorussian State University, Minsk

[Abstract] A sawtooth-voltage oscillator is described in which the amplitude of the waveform is held constant by automatic variation of the charge current through negative amplitude feedback. This generator is designed for phase-afc systems with pulse-amplitude modulation that are used as frequency multipliers. The device is based on series 153, 155 and 190 microcircuits. The peak-to-peak amplitude of the output wave is from -14 to +7 V, and changes by 2 dB or less with a change from 50 to 5000 Hz in the input signal frequency. The nonlinearity of the output voltage in the given frequency range is 10 percent. The time of the transient process is 3 ms or less with a frequency jump from 50 to 5000 Hz. Figures 1; references: 4 Russian.

[261-6610]

USSR

UDC: 621.373.089.6:006.354.065

#### A PULSE-TYPE SPECTRUM GENERATOR FOR THE TESTING OF INSTRUMENTS WHICH MEASURE RADIO INTERFERENCE OVER THE 0.1-30 MHz RANGE

Moscow IZMERITEL'NAYA TEKHNIKA in Russian, No 3, Mar 79 pp 45-47

PEREVERZEV, L. A. and KORNYSHOV, N. I.

[Abstract] Instruments for measuring radio interference with pulses are



checked, according to the GOST 11001-69, on the basis of their pulse characteristic and ratio of rms sine-wave voltage to equivalent spectral density of pulse voltage ("amplitude ratio"). A spectrum generator has been developed for both direct measurement of the amplitude ratio after calibration against the spectral density and its indirect determination from the harmonics. The spectral density is measured on the basis of the constant components in a signal, according to an approximation valid for the low-frequency range of the spectrum of a short pulse. A uniform spectrum of necessary intensity is produced by a sequence of video pulses, a short risetime being achieved by amplification-limiting with semiconductor devices in the preliminary small-signal stage and with electron-tube devices in the final large-signal stage. The spectral density is made to be independent of the pulse repetition rate by way of special pulse shaping. Overload protection is provided by delay lines. An error analysis of measurements of the amplitude ratio indicates that indirect determination is preferable for all interference meters with an adequately sharp discrimination of harmonics. Figures 1; references: 3 Russian.

[248-2415]

USSR

UDC: 621.3.017;621.311

ANALYSIS OF LOSSES OF ELECTRIC ENERGY IN POWER SYSTEMS OF THE NATION

Moscow ENERGETIK in Russian No 6, Jun 79 pp 4-5

FAYBISOVICH, D. L., YURTSEVA, V. N. and ZAKHAROVA, S. N., engineers

[Abstract] Fuel savings in the power industry involve a reduction in specific expenditures on electric power plants, and a reduction in losses of electric power in transmission and distribution networks. While there has been considerable progress in cutting fuel expenditures in electric plants (from 471 g/kWh in 1960 to 336.8 g/kWh in 1976) there has been a relative growth in energy losses (from 6.1 percent in 1960 to 9.15 percent in 1976). An analysis is made of the causes for this situation, which include the increased percentage of 10-0.4 kV rural power lines on which losses are as high as 15-20 percent, and the increased level of losses in transmission networks of 35 kV and more. These losses reflect a radical modification of the power industry structure, and are objective in nature. In addition, there are a number of other causes such as insufficient volume of construction work on power networks, low voltage levels in 35-220 kV transmission lines which cause low-voltage problems in the distribution networks, and uneconomic organization of operational work in the networks. Steps that can be taken to reduce energy losses include optimizing working conditions in the networks, eliminating parallel operation of nonuniform networks, disconnecting transformers under light loads and replacing unloaded transformers, and also phase-balancing the loads in 380 V lines. Additional capital investments should be made in load compensators and higher-power transformers in 220-330 kV substations. Tables 1.

[238-6610]

USSR

UDC: 621.311.4.017.001.24

DETERMINATION OF ELECTRICAL ENERGY LOSSES IN OPTIMIZING CONDITIONS OF  
ELECTRIC POWER SUPPLY IN INDUSTRIAL ENTERPRISES

Moscow ELEKTRICHESTVO in Russian No 6, Jun 79 pp 52-54 manuscript received  
19 Jul 78

SALAMATOV, I. A., IGUMENSHCHEV, V. A. and KOVALENKO, YU. P., Magnitogorsk

[Abstract] A probabilistic statistical model of an electric loading schedule is used in calculating losses of electrical energy in the power supply

systems of industrial enterprises. Formulas are given for calculating the statistical characteristics of the active and reactive power and losses of electrical energy. The proposed method dynamic calculation of losses was used in solving problems in optimizing the working conditions of electric power supply in the Magnitogorsk Metallurgical Combine. Comparative analysis of the relative error of calculation shows that there is almost no improvement of accuracy when the characteristics of daily schedules are used instead of average characteristics. Tables 3; references: 4 Russian.

[239-6610]

USSR

UDC: 621.319.44:621.316.1

ACCOUNTING FOR TECHNICAL CONSTRAINTS IN THE DESIGN OF DISTRIBUTION NETWORKS  
BY THE METHOD OF DYNAMIC PROGRAMMING

Minsk IZV. VUZ: ENERGETIKA in Russian, No 6, Jun 79 pp 29-34 manuscript  
received 16 Mar 79

ARION, V. D., candidate in technical sciences

[Abstract] Technical constraints on the variables give rise to algorithmic and mathematical difficulties in problems of conditional optimization. Here compensation of reactive power in distribution networks is considered, with technical constraints on the networks components as well as operating parameters taken into account. The method of dynamic programming is applied to the problem of optimal compensation of reactive power in terms of minimum cost, under five constraints: balance of reactive power, permissible power of reactive power sources, permissible current loading of network components, limiting levels of node voltages, and step-up ratios in the transformers. One way to account for these technical constraints is first expressing the last three of them explicitly in terms of the power of the sought reactive power sources so as to reduce the optimization process to one control variable. Another way is to include also the operating parameters in the optimization process so as to attain a better precision. Typical numerical calculations illustrate that the cost of an optimum design on this basis is somewhat higher than that of an optimum design not taking into account those constraints, but remains lower than the cost of no compensation as well as that of full compensation. The paper was presented by the Department (Kafedra) of Electrical Systems, Kishinev Polytechnical Institute imeni S. Lazo. Figures 3; tables 1; references: 2 Russian.

[281-2415]

USSR

UDC: 535.215:621.383

## SUPPRESSION OF EXCESS NOISE IN PHOTORECEIVER MATRICES WITH SIGNAL ACCUMULATION DURING FRAME SUBTRACTION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1419-1429 manuscript received 6 May 77

TRISHENKOV, M. A.

[Abstract] Photoreceivers with charge coupling or other matrix types are very sensitive, owing to signal accumulation, but not as noise immune as an ideal photoreceiver with an optimum filter. Here the performance of a matrix cell is compared with that of an ideal photoreceiver in terms of the signal-to-noise ratio. Such a cell is represented by an equivalent circuit of two current generators in parallel and across a storing capacitor: a photoconduction current generator and a noise current generator, the noise current being additively due to thermal and background radiation. The analysis based on this equivalent circuit takes into account the waveform of an incident light pulse, rectangular or distorted into a bell-shaped one, and its generally random position in time relative to the read-out period. Subtraction of two frames is considered and the excess noise calculated as a function of the time shift between them relative to the accumulation period. The transient characteristic of an accumulator, its pulse response, is derived from Duhamel integrals describing the charges. The dispersion of the charge signal is calculated on the basis of amplitude-frequency characteristics. The results indicate that the signal-to-noise ratio is maximum with the light signal centered within the accumulation period. The expressions for the signal-to-noise ratio in such a photoreceiver are essentially the same as those applicable to an ideal one, with either white noise or predominately  $1/f$ -noise, except for a smaller numerical factor in the numerator and a larger numerical term in the denominator. This ratio can be increased only by increasing the number of cells and at the same time reducing the excess noise. Figures 5; references 15: 5 Russian, 10 Western.

[273-2415]

USSR

UDC: 621.3.032.217

## CHEMICAL PROCESSES DURING PRODUCTION OF PHOTOCATHODES BASED ON GALLIUM ARSENIDE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1433-1439 manuscript received 18 Nov 77

GUGEL', B. M., MELAMID, A YE. and STEPANOV, B. M.

[Abstract] The physical model of photocathodes based on  $p\text{-GaAs:Cs}_2\text{O}$

involving a 3-stage photoelectric effect at the semiconductor surface has been proved out experimentally. Here the chemical model is constructed which explains the technological characteristics of their production: the requirement to minimize the carbon impurity, the roles of cesium vapor and cesium oxide, and the nature of adsorption and desorption processes. Formation of a p-GaAs:Cs<sub>2</sub>O photocathode is analyzed on the basis of at least six possible chemical reactions of gallium arsenide with oxygen and the temperature-dependent Gibbs energy corresponding to each. Calculations indicate that the most probable reaction occurring at the surface is oxidation of gallium arsenide to gallium arsenate in excessive oxygen or formation of gallium trioxide in deficient oxygen, followed by reduction of gallium oxides by atomic cesium after the latter had been adsorbed. Oxygen (gallium oxide) and cesium are then desorbed, cesium at a lower temperature. Formation of anion vacancies is found to play the main contributing role, their formation being enhancable by heating gallium arsenide to a sufficiently high temperature near 700 K or by mechanical treatment under vacuum. The detrimental effect of dissolved carbon is attributable to the acceptor nature of carbon centers in gallium arsenide, which contributes to a rise in the excess concentration of free electrons. Tables 1; references 16: 6 Russian, 10 Western.

[273-2415]

USSR

UDC: 621.383.4

# MICROWAVE-BIASED PHOTORESISTOR DETECTOR BASED ON EXTRINSIC SEMICONDUCTOR MATERIALS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian No 5, 1977 pp 1024-1030  
manuscript received 3 Jan 77; after revision, 25 Apr 78

ANTONOV, V. V.; VOYTSEKHOVSKIY, A. V., LILENKO, YU. V.; LANSKAYA, O. G.  
and PETROV, A. S.

[Abstract] The operating principle of a photoresistor detector (FRP) with microwave bias is based on the recording of a change in conductivity of a semiconductor specimen biased in a microwave field under the influence of sensed emission. With this method of recording photoconductivity, the sensing semiconductive crystal is placed without contact in the microwave field. This eliminates constraints imposed on the value of bias voltage associates with the formation of a space charge in a continuous electrical field. A doped photoresistor with microwave bias at a wavelength of 10.6 micrometers has been fully investigated. Insertion of doped photoresistors to a microwave resonator with counter clamps and the use of a microwave circuit with a synchronous balance detector makes it possible to realize

the characteristics of a photodetector defined by the parameters of the semiconductor sensing crystal. This circuit is applicable to study electrophysical, photoelectrical and noise properties of doped semiconductor materials because of the high sensitivity of the proposed method of contact-free recording of impurity photoconductivity guaranteed by total insertion of specimens with different specific resistance in the microwave field of a resonator and application of intense electrical fields. Figures 2; Tables 2; references 15: 9 Russian, 6 Western.

[230-8617]



USSR

UDC: 535.3:621.375.826

## REFLECTION OF LIGHT BY AN AMPLIFYING MEDIUM

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1979 pp 913-918 manuscript received 3 May 78

LUK'YANOV, YU. N. and PAN'KIN, V. G.

[Abstract] Interest in reflection of light by an amplifying medium arose with the discovery that the energy coefficient of reflection can exceed unity and attain values of  $10^3$ . Light reflection was investigated on three-dimensionally uniform (OUS) and three-dimensionally nonuniform (NUS) amplifying media. Adoption of the model of a semifinite medium is possible if the effect of the other boundary layer can be ignored. In practice, great values of energy coefficient of reflection (EKO) of  $10^2$  to  $10^3$  may be derived for reflection on the interface of two media with close indexes of refraction and with reflective gain typical of solid-state lasers. Study of non-linear effects associated with saturation of amplification in an inverted medium with reflection of light on its boundary is important. Figures 3; references 11: 10 Russian, 1 Western.

[230-8617]

USSR

USSR: 621.373.826

## SUBHARMONIC PARAMETRIC RESONANCE IN A RING LASER WITH PERIODIC FREQUENCY BIAS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1230-1232 manuscript received 17 Jul 78

KHOSHEV, I. M.

[Abstract] A characteristic feature of the frequency response of a ring laser with periodic frequency biasing is the presence of zones of parametric synchronization where the beat frequency is a multiple of the bias frequency, "integral" zones. Investigation of the equations of a ring laser by electronic simulation reveals a "half-integral" zone on the frequency response curve where the beat frequency is equal to half the bias frequency. Analysis of these equations in the case of periodic biasing has shown that this and other half-integer zones where the beat frequency is a half-multiple of the bias frequency arise in the square-law coupling approximation. Expressions are derived for the averaged beat frequency, the half-width of the half-integral zone, and the phase difference of opposed waves. References: 3 Russian.

[244-6610]

USSR

UDC: 523.2:523.164.8

INVESTIGATION OF ATTENUATION OF RADIO WAVES IN THE ATMOSPHERE OF VENUS BY THE BISTATIC RADAR METHOD

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 22, No 6, 1979 pp 675-681  
manuscript received 22 May 78, after completion, 15 Dec 78

KUCHERYAVENKOV, A. I., YAKOVLEV, O. I., PAVEL'YEV, A. G., MASHKOV, V. I., MILEKHIN, O. YE. and RUSETSKIY, V. I., Institute of Radio Engineering and Electronics, Academy of Sciences USSR

[Abstract] Recent bistatic radar studies with the Venera-9 and Venera-10 interplanetary probes have shown the feasibility of using this technique to investigate attenuation of radio waves in the atmosphere of Venus. The authors analyze the first results of measurement for the refraction attenuation of radio waves in the atmosphere of Venus and compare these measurements with theoretical calculations. It is found that the atmosphere of this planet has a considerable influence on the energy characteristics of radio waves. The energy flux of a radio wave propagating in the atmosphere of Venus is considerably reduced. This reduction is due to refraction attenuation and possible absorption in gases and water vapor. Attenuation on a wavelength of 32 cm is about 8 dB when the glancing angle is about 9°. This attenuation can be attributed chiefly to the influence of refraction in the atmosphere. The amount of absorption in this instance is not more than 1 dB. The results of this study show that bistatic radar systems provide an excellent tool for studying planetary surfaces and atmospheres, and also confirm the adequacy of the present theory of propagation of radio waves in the dense atmosphere of Venus for the decimeter waveband. Figures 5; references 9: 6 Russian, 3 Western.

[251-6610]

USSR

UDC: 538.574.4

SCATTERING OF WAVES IN A LAYER WITH INHOMOGENEITIES LYING ABOVE A MIRROR REFLECTOR

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 22, No 6, 1979 pp 728-732  
manuscript received 13 Jun 78

BUBUKIN, I. T., Scientific-Research Institute of Radio Physics

[Abstract] In certain applied problems, the surface of the earth has a considerable effect on scattering of electromagnetic waves and on the power dissipation, for instance when studying the ground layer of the atmosphere

by airborne and satellite radar. In this paper an expression is derived for the radar scattering cross section of an inhomogeneous layer lying above an ideally reflecting surface. Previous studies of scattering of a plane wave in the case of normal incidence in a layer containing inhomogeneities lying above a reflector have shown a backscattering amplification effect. It is shown in this paper that this effect is quite appreciable in estimates of the scattering cross section at angles close to the nadir. In such cases the reflector increases the scattering cross section by nearly four orders of magnitude. An expression is derived for the Poynting vector when the source and observation point are in the Fraunhofer zone relative to the target region. These results pertain to an ideal reflector, and may be considerably modified by consideration of the actual roughness of ground covers. The author thanks V. P. Dokuchayev for constructive criticism, and K. S. Stankevich for discussing the results. Tables 1; references 3: 2 Russian, 1 Western.

[251-6610]

USSR

UDC: 621.396.96:621.391.26

# ONE INTERPRETATION OF AN OPTIMUM DETECTION ALGORITHM FOR A SIGNAL MASKED BY DISTRIBUTED NOISE REFLECTIONS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1979 pp 919-927 manuscript received 29 Mar 77

ABRAMOVICH, YU. I. and ZAYTSEV, S. A.

[Abstract] The relationship between optimum algorithms of two problems of the statistical theory of radar is examined: 1) The problem of detection of a signal masked by interfering reflections of localized range and Doppler frequency; and 2) The problem of identification of the linear channel generating the signal of interfering reflections. These two problems are interrelated, but no correlation has yet been found between their optimum algorithms. Output signal in the noise region generated by 100 bright spots is represented by a total of nine points (nodes of interpolation). Correlation between the optimum algorithm of detection of a signal masked by interfering reflections of localized range and velocity and the criterion algorithm of identification of the channel shaping this signal of interfering reflections which is optimum in terms of the criterion of the maximum a posteriori probability is found. The authors are deeply thankful to M. B. Sverdlik for assistance rendered and Ya. D. Shirman for discussion of the work and valuable remarks. Figures 2; references 12: 6 Russian, 6 Western.

[230-8617]

## EFFECT OF NONLINEARITY OF RECEPTION AND TRANSMISSION CHANNELS ON THE PRECISION OF MEASUREMENT OF THE POSITION OF OBJECTS IN A SHORT-RANGE RADAR

Moscow RADIOTEKHNIKA, Vol 34, No 6, Jun 79, pp 71-74 manuscript received after completion, 7 Jun 78

SHELUKHIN, V. I.

[Abstract] In systems of short-range radar intended for detection and measurement of local fixed objects, errors are possible connected with the nonlinearities of the receiving and transmitting circuits. Errors caused by the transmitting circuit result from the nonlinearity of the modulation characteristics, and the errors in the receiving circuit by the nonlinearity of the processes of detection and amplification. The present paper considers these errors in detail. Because during construction of systems of short-range radar (of the class under consideration) it is necessary in the receiving device to assure normalization of the signals, the most representative amplifier circuits are considered: an amplifier in a regime of thorough limitation of the signals and an amplifier with linear-logarithmic characteristics. Expressions are derived to describe the amplitude characteristics of these amplifiers. Figures 1; tables 1; references: 4 Russian.

[254-6415]

USSR

UDC: 621.376.3:621.374.4

CONCERNING AN INVESTIGATION OF THE TRANSITION OF AMPLITUDE MODULATION INTO PHASE (FREQUENCY) IN A CHANNEL OF RECEIVERS OF FM SIGNALS

Moscow RADIOTEKHNIKA, Vol 34, No 6, Jun 79, pp 66-68 manuscript received after completion, 11 Aug 78

KASHCHENKO, O. B. and PAVLENKO, YU. F.

[Abstract] An investigation is made of the transition of amplitude modulation into phase in a measuring FM receiver. Some sources of and the mechanism of the formation of an AM--FM transition are analyzed. It is concluded that there is a specific nature in the operation of microwave FM receivers and measures of frequency duration (IDCh) connected with the fact that the mixer and input device at these frequencies can introduce an AM-FM transition substantially larger than at lower frequencies. Consequently, during designing of the mixers of FM receivers, it is necessary to take into consideration the possibility of resonance in the construction of mixers in the microwave band, as well as the necessity of fulfilling the condition  $U_{het} \gg U_{sig}$ , particularly during operation at heterodyne harmonics. Checking of an IDCh with respect to an AM-FM transition only at low carrier frequencies is insufficient, particularly if its use in the microwave band is proposed for measurement of small deviations in frequency fluctuations when an AM-FM transition in an IDCh circuit can introduce a substantial error. One of the possible means for investigation of mixers in the microwave band may be the proposed variation of the twofold use of the two-channel method. Figures 1; references: 2 Russian.

[254-6415]

USSR

MODEL KRS-78 TRANSCEIVER: PART 3

Moscow RADIO in Russian No 6, 1979 pp 17-21

KOBZEV, V. (UW4HZ), ROSHCHIN, G. (UA4IQ), and SEVAST'YANOV, S. (UA4HAD), radio amateurs, Kuybyshev

[Abstract] This is the concluding article on the KRS-78 transceiver. Schematic diagrams are given for the circuit-board connections and for the power supply. Operation is from a 220 VAC line. Photographs are given showing the arrangement of components and wiring. The article also gives details on construction, and coil winding data (number of turns, type of wire, inductance). This transceiver has been used since October

1977 at radio station UW4HZ. It was also operated at station UK4HAW during the Soviet championship tournament on shortwave telephony. The authors thank V. Petukhov from Cheboksary for assistance in making the transceiver and preparing this material for publication. Figures 4.

[253-6610]



USSR

UDC: 53.072:51.13

## DIELECTRIC PROPERTIES OF POLAR LIQUIDS DUE TO SUPER-DEBYE INTERACTION WITH A MICROWAVE FIELD

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1170-1183 manuscript received 23 Oct 77

GAYDUK, V. I., KALMYKOV, YU. P. and TSEYTLIN, B. M.

[Abstract] Previous research on the interaction of microwaves with polar liquids has shown that as long as response is linear, admittance can be calculated by finding the correlation functions of fluctuation in the state of thermodynamic equilibrium (the fluctuation-dissipation theorem). As applied to permittivity  $\epsilon = \epsilon' - i\epsilon''$ , this means that the dispersion dependence  $\epsilon(\omega)$  can in principle be determined from the microscopic correlation function  $C(t) = \langle \vec{u}(0)\vec{u}(t) \rangle$ , where  $\vec{u}$  is a unit vector in the direction of dipole moment  $\vec{\mu}$  for a single dipole, and the angle brackets denote averaging with respect to the dipole ensemble. The function  $C(t)$  is found by analyzing the thermal motion of dipoles that is unperturbed by the microwave field. In this paper, the response of the medium to external stimulus is found by calculating the dipole trajectories that are perturbed by the microwave field, and then averaging the work done by the field during the dipole lifetime. This method is used to study a limited rotator model of the liquid with consideration of the contribution of rotational diffusion and rotational oscillation of molecules in the permittivity of the medium, taking the molecules as rigid rotators. The case of a potential well with perpendicular walls is considered. Formulas are derived for calculating the permittivity components in terms of model parameters. The authors thank V. I. Yermakov and V. V. Levin for constructive criticism. Figures 4; tables 2; references 26: 15 Russian, 11 Western.

[244-6610]

USSR

UDC: 535.215.1.5:621.383

## DURATION OF THE MULTIPLICATION PROCESS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1235-1237 manuscript received 6 Jul 77

MERKISHIN, G. V.

[Abstract] One of the factors that limit the speed of devices based on current carrier multiplication in the strong-field region (usually the space charge region of the p-n junction) is the duration of the multiplication process. The author determines the average duration of this

process for the case of equal ionizing capabilities of electrons and holes. It is assumed that the electric field is constant and uniform within the limits of the multiplication layer, that current carriers of both signs have the same drift velocity and their ionizing capabilities are equal, that a given number of ionization events occurs as a result of injection of a single current carrier, and that a particle entering the multiplication layer and each of the resultant particle pairs (except the last) is responsible for one ionization. The probability of recombination within the multiplication layer is disregarded. It is shown that the average duration of the multiplication process is approximately equal to  $m\tau_{dr}/3$ , where  $m$  is the number of ionizations resulting from injection of a single current carrier, and  $\tau_{dr}$  is the time of particle drift through the multiplication layer. Figures 2; references 6: 5 Russian, 1 Western.

[244-6610]

USSR

UDC: 539.1.074

#### MOSAIC SEMICONDUCTOR DETECTORS OF NUCLEAR RADIATION

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 79 pp 83-86  
manuscript received 2 Nov 77

NIKITIN, B. A., ZAKHARCHUK, O. V., KONOVALOV, A. O., SLIVA, A. V. and FEDOSEYEVA, O. P.

[Abstract] Semiconductor detectors with large area are often needed in registration of low-intensity radiation. Since silicon crystals suitable for detectors are difficult to make in large sizes, the best course is to use small detectors connected in parallel in a mosaic. This technique brings up questions of choosing the parameters of the individual modules that will give predetermined parameters of the mosaic, or determining the mosaic parameters from given characteristics of the individual cells. This article deals with the mutual relations between the parameters of the individual modules and the spectroscopic properties of the resultant matrix. An analysis is made of the way that the energy equivalent of fluctuations of charge of the mosaic depends on the known energy equivalent of charge fluctuations of the separate modules. A method is given for calculating the energy resolution of a semiconductor detector from the energy equivalent of noise and the energy equivalent of fluctuations in the amplitudes of charge pulses. It is shown that fluctuations in the amplitudes of charge pulses are a major factor in the energy resolution of a mosaic with small area, while the energy resolution is determined chiefly by noise in mosaics of large area. Photographs are given of MDKD-4 mosaic detectors, and a table is presented that summarizes the characteristics of these detectors. Figures 4; tables 1; references: 2 Russian.

[261-6610]

## MICROWAVE GENERATION BY A GUNN DIODE ON THE SECOND HARMONIC OF THE RESONATOR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1232-1234 manuscript received 28 Jun 77

PROKHOROV, E. D., POLYANSKIY, N. YE., BELETSKIY, N. I. and DROGACHENKO, A. A.

[Abstract] Recent theoretical and experimental research has been devoted to the idea of using higher harmonics (in particular the second) of the electric field strength acting in a diode to improve the energy characteristics (primarily the efficiency of signal generation) of Gunn oscillators on the fundamental of the resonator. As the maximum frequencies generated by Gunn diodes are pushed further toward the shortwave end of the millimeter band, it is becoming more important to get highly efficient oscillation on the second harmonic of the resonator. This inverse problem is theoretically and experimentally studied in this report. The theoretical calculations show that when the amplitude ratio of the second harmonic to the fundamental is between 0.8:1 and 1:1, the efficiency of oscillation on the frequency of the second harmonic may reach 10-12 percent at 300 K, and 5-6 percent at 500 K. These results are confirmed by experiments with Gunn diodes in coupled resonators in the 8-mm and 4-mm bands, and in the 4-mm and 2-mm bands. Figures 3; references 8: 2 Russian, 6 Western.

[244-6610]

## COMPARISON OF GOLD- AND PLATINUM-DOPED POWER DIODES AND TRANSISTORS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1979 pp 1050-1054 manuscript received 2 Sep 77

ASINA, S. S.; DUMANEVICH, A. N.; RUKHAMKIN, V. M. and KUZ'MIN, V. L.

[Abstract] Platinum, like gold, creates effective recombination centers in a silicon lattice; thus it can be used to reduce the lifetime of charge carriers in high-speed devices. The position of donor levels of platinum and gold in the silicon forbidden zone is roughly identical, whereas the acceptor level of gold is much deeper than that of platinum. Such a distinction can become principle in silicon power devices which are usually produced on high-ohm n-type material. The basic parameters of silicon diodes and thyristors doped with gold and platinum were compared. The effect of diffusion of gold and platinum on the operating characteristics of power diodes and thyristors indicates the following

advantages for using platinum instead of gold: 1) Reduction of diode and thyristor leakage currents under operating conditions; 2) Increased operating temperature of silicon devices; 3) Improved temperature stability of basic device parameters; and 4) Possibility of a wide range of control of switching time in thyristors and reverse recovery time in diodes by altering current density in the conducting state. Figures 7; references 5: 1 Russian, 4 Western.

[230-8617]

USSR

UDC: 621.382.3

A MULTIEMITTER SILICON POWER TRANSISTOR FOR CURRENTS OF THE ORDER OF 40 A

Yerevan DOKLADY AKADEMII NAUK ARMYANSKOY SSR in Russian Vol 48 No 3, 1979 pp 163-170

AVAK'YANTS, G. M., associate member, Academy of Sciences, Armenian SSR, BARSEGYAN, R. S., GUKASYAN, M. A., MINASYNA, M. V. and SARKISYAN, S. A.

[Abstract] The authors have developed a new multiemitter power transistor with diffusion ballast resistors connected in series to a group of emitter combs. The proposed design has the distinguishing feature that the emitter combs connected to one resistor are interconnected in parallel, the number of combs depending on the current that is taken off from one comb, and also on the limiting resistance. To optimize the area of the transistor, the distance between emitter combs is given by the formula  $d \approx \sqrt{\text{const } \Delta}$ , where  $d$  is the width of the emitter comb, and  $\Delta$  is the distance between combs. The constant under the radical ranges from 1 to  $100 \mu\text{m}^2$ . The devices are produced by a conventional planar technique. The initial material is a silicon plate with epitaxial films of  $n^+-n$  type, and boron is used as the dopant for producing the base region. The transistor structure measures about  $10 \times 10$  mm. Saturation voltage in a common-emitter circuit is 1.5-2 V at a current of 30-40 A. Maximum permissible collector-emitter voltage is about 160-200 V. Figures 3; references: 2 Russian.

[257-6610]

USSR

UDC: 533.9.68:533.932/933

## A METHOD OF DETERMINING THE COMPLETE ELECTRON CONCENTRATION PROFILE IN A PLASMA

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1461-1463 manuscript received 20 Jun 77

KARTASHEV, V. G. and SKACHKOV, V. L.

[Abstract] The problem of plasma diagnosis with a plane electromagnetic wave is considered, namely determination of the complete electron concentration profile from respective probing data. The method shown here is based on the quantum theory of scattering and on solving the reverse problem of wave propagation through a nonhomogeneous plasma layer with a known complex reflection coefficient. It involves an inverse Fourier transformation of the pulse response characteristic. A numerical solution is obtained by the grid method, after a discrete Fourier transformation and interpolations according to a Kotel'nikov series. The method is applicable to plasma layers of any thickness, but the width of the resulting profile diagram will be limited by the computer capacity and the error of reflection coefficient measurement. Figures 2; references 8: 7 Russian, 1 Western.

[273-2415]

USSR

UDC: 537.86

## USING A SPHERE FOR REPRESENTATION AND ANALYSIS OF ELECTROMAGNETIC FIELDS IN A THREE-DIMENSIONAL UNITARY SPACE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 7, Jul 79 pp 1264-1271 manuscript received 23 Oct 78

ZHIVOTOVSKIY, L. A.

[Abstract] The concept of the Poincaré sphere for representing the polarization of light is extended so as to apply also to electromagnetic fields not reducible to a two-dimensional polarization basis. Accordingly, a field is considered equal to the sum of incoherent fields of quasi-monochromatic plane waves with mutually not parallel fronts. Fluctuations of this field are assumed to be stationary and stationarily bound, at least in the broad sense, and its coherence matrix is a nonnegative-definite hermitian so that a unitary basis exists where this matrix becomes a diagonal one. With the application of spherical trigonometry, the three-dimensional unitary space containing such an electromagnetic field is mapped onto a unit sphere. The latter is found to be less universal than the Poincaré sphere, but useful for representing and analyzing fields with complete, partial, or random polarization. Figures 6; references 10: 6 Russian, 4 Western.

[273-2415]



# USING GENERALIZED COEFFICIENTS OF HARMONIC LINEARIZATION TO DETERMINE THE PARAMETERS OF SELF-OSCILLATORY WORKING CONDITIONS

Moscow AVTOMATIKA I TELEMEXHANIKA in Russian No 4, 1979 pp 26-30 manuscript received 29 May 78

VOLOVODOV, S. K. and ROZENVASSER, YE. N., Leningrad

[Abstract] The author considers the problem of approximate determination of the parameters of symmetric self-oscillations in a nonlinear system of the form  $y=W(p)x$ ,  $x=f(y)$ , where  $W(p)$  is the transfer function of the linear part of the system and  $f(y)$  is a nonlinear symmetric function. The exact expression of the periodic process at the output of the linear process is  $y(t)=a \sin \omega t + \Delta(\omega t)$ , where  $a$ ,  $\omega$  are the values of the amplitude and frequency of the first harmonic, and  $\Delta(\omega t)$  is the sum of the higher harmonics beginning with the third. If  $|\Delta(\omega t)| \leq ka$ , then

$$q_{\max}(a,k) \geq \operatorname{Re}[W^{-1}(i\omega)] \geq q_{\min}(a,k),$$

$$q'_{\max}(a,k) \geq \operatorname{Im}[W^{-1}(i\omega)] \geq q'_{\min}(a,k),$$

where  $q_{\max}(a,k)$ ,  $q_{\min}(a,k)$ ,  $q'_{\max}(a,k)$  and  $q'_{\min}(a,k)$  are generalized coefficients of harmonic linearization. It is shown that such coefficients can be used to evaluate parameters of self-oscillations in cases where the method of harmonic balance is inapplicable. Figures 6; references: 3 Russian.

[256-6610]

# EFFECTIVE "IN PLACE" ALGORITHM FOR THE FAST WALSH TRANSFORM

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1979 pp 945-949 manuscript received 2 Nov 77

TRUSHKIN, A. V.

[Abstract] Walsh functions in a finite set of  $N = 2^n$  points are represented as lines of a quadratic matrix of  $N$  order. According to the arrangement of lines, various matrices are formed, among which are customarily specified Adamar, Paley and Walsh matrices. Lines of the Walsh matrix are arranged in ascending order of so-called frequency of recurrence, which is equal to the number of sign changes in a given lines. The fast in-place Walsh



transform in the form of a Minsk-32 computer program was reported by P. M. Chegolin et al (Izd. In-ta Tekhnicheskoy Kibernetiki AN BSSR, Minsk, June 1973, 121). There, the vector is subject to binary inversion and is then transformed. Figures 4; references 8: 3 Russian, 5 Western.

[230-8617]

USSR

UDC: 519.216.1/2

#### FAST WALSH TRANSFORMS FOR SLIDING SPECTRUM ANALYSIS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 5, 1979 pp 950-957 manuscript received 13 Feb 78

SMIRNOV, YU. M.: VOROB'YOE, G. N.: POTAPOV, YE. S. and SYUZEV, V. V.

[Abstract] Systems of discrete Walsh functions have recently found application in solving various problems of digital data processing and spectral analysis of experimental data. Fast Walsh transforms enable us to determine the spectrum of an N-dimensional sampling of discrete signals for  $N \log_2 N$  additions. In some cases it is necessary to determine the current (sliding) spectrum, especially in real-time. Many fast Walsh transforms (BPU) are essentially static type algorithms, because they only operate with samples accumulated by the instant of computation and do not take into account the results of prior calculations. It is possible to construct effective fast transforms for a sliding analysis of the Walsh spectrum. The method of time dilution requires less volumes of data in constructing fast sliding algorithms, theoretically distinguishing sliding BPU from fast static transformations. Figures 5; references 6: 5 Russian, 1 Western.

[230-8617]

## DISTRIBUTIONS OF CHARGES ON A MOVING PROCESS BELT IN THE ELECTRIC FIELDS OF POINT AND LINEAR SOURCES

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 6, Jun 79  
pp 485-490

SLYSHALOV, VLADIMIR KONSTANTINOVICH, candidate in technical sciences,  
Docent, Ivanovo Power Engineering Institute

[Abstract] The author considers the problem of the distribution of electric charges over the surfaces of moving belts made of imperfect dielectrics such as paper, fabric and various types of film materials. It is assumed that an initially uncharged belt made of a homogeneous, isotropic dielectric moves in a given electric field at a given velocity. The belt is taken as infinite in the longitudinal direction, with a transverse dimension much greater than its thickness. It is assumed that the specific conductance of the belt material is given, as well as the relative dielectric constants of the belt and the ambient medium. Belt velocity in practice is about 10 m/s, and therefore it can be assumed that the polarization process is independent of belt motion. The problem is formulated for both point and linear field sources. Patterns of charge distribution are established that are common to all problems of motion of an imperfect dielectric belt in an electric field. Figures 4; references: 6 Russian.

[252-6610]

## USING SYNCHRONIZATION OF A MICROWAVE SELF-EXCITED OSCILLATOR BY AN EXTERNAL SIGNAL TO MEASURE PARAMETERS OF NONLINEARITY OF ITS ELECTRONIC CONDUCTIVITY

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1110-1117 manuscript received 5 Nov 77

MALYSHEV, V. A., ROZDOBUD'KO, V. V. and GOLOVKIN, A. S.

[Abstract] To determine electronic conductance and its nonlinear properties in active microwave devices such as reflex klystrons, magnetrons, Gunn diodes and the like, direct microwave methods are used or the load characteristics of the oscillating device are taken. These techniques involve considerable errors associated with measurement of negative conductances, large standing wave ratios and the influence of the long-line effect. In this paper, a method is proposed for determining the coefficients of dependence of the electronic conductance of self-excited oscillators

as a function of the square of the voltage amplitude by experimentally plotting a so-called synchronization ellipse that shows the relative changes in the emitted power and frequency of the microwave oscillator to be synchronized with a change in the phase or frequency of the input signal. The method is illustrated by plotting experimental synchronization ellipses for a Gunn-diode oscillator. Figures 2; references: 7 Russian.

[244-6610]

USSR

UDC: 621.382.333

ANALYSIS OF TRANSIENT PROCESSES OF A CAPACITIVE RELAXER BASED ON AN AVALANCHE TRANSISTOR WITH CONSIDERATION OF PRINCIPAL LAG FACTORS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 6, Jun 79 pp 1103-1109 manuscript received 3 Jun 77

D'YAKONOV, V. P.

[Abstract] Relaxers based on avalanche transistors shape powerful nanosecond pulses with rise time of about 0.1-1 ns. GT338A-GT338V avalanche transistors, KT312 and KT603 planar-epitaxial silicon transistors and others operate in the avalanche mode with a limited space-charge region and a transit time of much less than 1 ns for minority carriers through the active region of the device. In this case, the external lag of the discharge circuit of the relaxer due to unavoidable parasitic inductance must be considered in addition to the lag of the transistor itself. An analysis is made of the transient processes in a capacitive relaxer with consideration of all the major processes that contribute to lag. The calculations are done on a Mir digital computer equipped with a television display. An experimental study of a large number of series GT388 avalanche transistors showed that the calculations agree with experiment both qualitatively and quantitatively. Discrepancies are within the limits of precision of measurement of the transistor parameters. The authors thank T. A. Samoylova for assisting with the calculations and programming the computer. Figures 7; references 10: 9 Russian, 1 Western.

[244-6610]

CSO: 1860

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